DOMINUS®

STEWARDSHIP AND TRAINING MANUAL

July 2014

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DOMINUS®

STEWARDSHIP PROGRAM

INTRODUCTION

1) The DOMINUS® Soil Fumigant Stewardship and Training Program:

This application manual is to be used in accordance with all label requirements. In all cases the approved and registered labels take precedence over any recommendation and/or guidance provided herein. The information provided in this manual is to be considered recommendations for the proper use and application of DOMINUS® pre-plant fumigant with approved soil injection equipment.

Along with every use and application of DOMINUS® is a comprehensive stewardship program whose main objective is to establish a DOMINUS® Soil Fumigant Stewardship and Training Program that promotes the safe handling of DOMINUS® Technical, and its formulations, and to ensure that DOMINUS® product(s) are used in a manner consistent with all label requirements and use directions.

All applicators and handlers of DOMINUS® are required to successfully complete the annual DOMINUS® Stewardship and Training Program prior to use.

2) About This Manual:

The DOMINUS® Soil Biofumigant Stewardship and Training Manual is advisory in nature and provides additional information and recommendations for the use of DOMINUS® formulations. This training manual is not to be interpreted as label language and as such does not replace use instructions and restrictions provided by DOMINUS® labels. In all cases the product label contains the most current use instructions and restrictions for use of DOMINUS® formulations and supersedes any recommendation contained in this manual. The user shall comply with all directions contained in the product label.

ISAGRO USA has developed the DOMINUS® Soil Biofumigant Stewardship and Training Program for distributors and applicators using DOMINUS® formulations. ISAGRO USA will conduct and support annual training for distributors and applicators and will make all training materials available for use by DOMINUS® approved distributors and applicators for use in training site-specific personnel as required

3) Product Stewardship and Compliance:

ISAGRO USA is committed to ensuring the safe handling, distribution and use of DOMINUS® products. ISAGRO USA will work with distributors, applicators, growers and state regulatory officials to ensure compliance with all use restrictions and regulatory requirements.

By participating in the DOMINUS® Soil Fumigant Stewardship and Training Program, distributors and applicators make their own commitment to comply with all label language including use restrictions and safety requirements.

In addition to providing training materials, classroom instruction, and in-field guidance and support, ISAGRO USA intends to fully investigate and report incidents involving misuse or non-compliance. Distributors and applicators who do not comply with all product use requirements will not be allowed to continue to distribute or use DOMINUS® formulations.

All incidents occurring during the application process or handling or transportation of DOMINUS® product must be reported to ISAGRO USA by calling the ISAGRO Representative for Eastern Atlantic territories at 863-840-460 and in Western Pacific territories at 559-903-4653. An Incident Reporting form is available from your ISAGRO USA representative, Distributor and/or electronically in the DOMINUS® folder @ www.isagro-usa.com (password protected).

DOMINUS® - Qualified Applicator Responsibilities

4) Stewardship and Training Program Overview:

ISAGRO USA has developed the DOMINUS® Stewardship and Training Program for applicators, handlers and distribution personnel.

These individuals are required to have a high level of knowledge and proficiency in the application and handling of DOMINUS®

5) Objectives of the DOMINUS® Biofumigant Stewardship Program:

- Promote the safe handling of DOMINUS®
- Ensure that DOMINUS® products are used in a manner consistent with all label restrictions and use directions
- Scope of the ISAGRO USA training program is to provide comprehensive training to buyers and end users of DOMINUS® product(s).

6) Requirements for ISAGRO USA Qualification:

Reading Requirements

- Stewardship and Training Manual
- Application Equipment Technical Data Sheet
- Product Labels
- Material Safety Data Sheet (MSDS)

Training Course Requirements

- Course participation (presentations, focused on attention to requirements for safe use and handling)
- Hand-out materials at training and available on line @ (www.isagro-usa.com)

ISAGRO USA Standards for Qualification and Commercial Use

- Must be knowledgeable in the handling and use of soil fumigants, and in particular the DOMINUS® application method(s)
- Must have participated in ISAGRO USA provided training course (theoretical and practical training)
- Must have read and understood required reading materials
- Must successfully exhibit appropriate knowledge of the product, its application, handling and requirements for protection of human health and the environment

Renewal of ISAGRO USA Qualification

- Annual participation in the ISAGRO USA qualification process is required. Distributors who have been trained by an ISAGRO USA representative and are proficient in all aspects of the ISAGRO Training program can be qualified to serve as trainers once approved by ISAGRO USA.

Applicator Requirements and Responsibilities

- All participants in the ISAGRO USA training program, whether provided by ISAGRO personnel or Designated Distributor Trainers, must understand and comply with all DOMINUS® label requirements.
- A person trained and knowledgeable on the product's technical and safe handling must be present at the fumigation site during the application and should be in the line of sight of the applicator.

The on-site applicator supervising the soil fumigation is responsible for all safety measures listed on product labels and required by applicable law, including, but not limited to the following:

- •Ensuring that all persons who are not trained and equipped with Personal Protective Equipment (PPE) and who are not performing one of the handling tasks listed on product labels are excluded from the application block during the entry restricted period;
- Ensuring that all handlers engaged in the handling and / or application of DOMINUS® are equipped with the label defined PPE and have been instructed in the proper use and maintenance of all PPE;
- Ensuring that all handlers who may or will wear a respirator understand its proper use to protect themselves against inhalation exposure;
- Ensuring that the 25' buffer zone measured from the edges of the treated area is maintained from the start of the application until 24 hours following the end of the application;
- Buffer zones must be under the control of the supervising applicator and must not include property that is not under the control of the supervising applicator unless written permission is obtained prior to fumigation. The supervising applicator must use an appropriate means to manage and maintain the buffer zone such as posting Buffer Zone signs around the perimeter of the buffer zone at potential points of entry, using trained workers to patrol the buffer zone, or other equivalent means. Buffer zones must be posted from the start of the application until 24 hours following the end of the application and must be removed within 3 days of the end of the buffer zone period. The buffer zone signs must include the same warning symbol and statements required for Fumigant Treated Area signs as stated on this label and / or in accordance with local governing laws and regulations.
- Ensuring that unprotected workers and bystanders (not in transit) do not enter the buffer zone from the start of the application until 24 hours following the end of the application. Ensure the buffer zone is well secured to prevent disturbance from animals and to keep unauthorized (non-fumigant) persons from staying in the treated area and/or buffer zone during the buffer zone period. However, travel by unprotected workers or bystanders through the fumigated or treatment area itself is prohibited during the entire Restricted Entry Period (REP). Handlers protected with required PPE may work in buffer zones. See the PERSONAL PROTECTIVE EQUIPMENT section on product labels;
- Ensuring that there are no "sensitive sites" within 100 feet of the edge of the fumigated area. A sensitive site is defined as occupied nursing homes, hospitals, or prisons; and occupied licensed schools, state licensed day care centers (any child care facility other than a family day care home, including infant centers, preschools, extended day care facilities and school age child care centers) playgrounds, and licensed assisted living facilities (licensed by state or local governments);
- Ensuring the use of standard Good Agricultural Practices (GAPs);
- Providing all other workers with appropriate information regarding the use of DOMINUS® products, and ensuring that all handlers follow required use directions and safety measures;

DOMINUS® Contact Information

DOMINUS® soil fumigant is a highly and acutely hazardous material. All uses of this fumigant are covered under appropriate local and/or regional Worker Protection Standards (WPS) and must be conducted in accordance with all Governmental, Regional and / or State requirements. It is not a restricted use pesticide however, it must only be used by supervising applicators, licensed by the Government, Regulatory Agencies and / or State(s) and trained by ISAGRO USA in the proper handling, worker protection, and application of DOMINUS® soil fumigant and handlers under their direct supervision. Before using, read the entire label and follow all use directions and precautions. All persons working with this fumigant must be knowledgeable about its hazards and trained in the use of required air-purifying respirator equipment and detector devices (as applicable), emergency procedures and proper use of the fumigant.

Contact your ISAGRO USA representative for details on obtaining approved company training, materials and qualification for use of DOMINUS®.

- ISAGRO USA Main Office Number: 919-321-5200
- ISAGRO Representative Eastern USA: 863-840-4600
- ISAGRO Representative Western USA: 559-903-4653

DOMINUS®

TRAINING MANUAL

CHAPTER 1:
DOMINUS® PRODUCT DESCRIPTION

DOMINUS® Product Overview

1) Hazard Characteristics:

OSHA Hazard Communication Standard Classification (29 CFR 1910.1200)

Signal Word: Danger

Pictograms:

Hazard Statements and Categories:

- **Acute Oral Toxicity:** Harmful if swallowed – Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product. If swallowed: call a poison center if you feel unwell. Rinse mouth.
- **Acute Dermal Toxicity:** Toxic when in contact with skin – Wear protective gloves and clothing. If on skin: wash with plenty of water. Call a poison center or doctor if you feel unwell. Immediately remove all contaminated clothing and wash separately from normal laundry before reuse. If clothes are contaminated beyond use follow all label instructions for proper disposal.
- **Acute Inhalation Toxicity:** Fatal if inhaled – Do not breathe mist, vapor or spray. Use product only outdoors or in a well-ventilated greenhouse or glasshouse. If product is inhaled move away from the source and upwind: If a person needs assistance wear a respirator and remove person to fresh air and upwind from source of contact. Immediately call a poison control center or doctor. If a person is unconscious and / or not breathing immediately call 911.
- **Skin Irritation:** Corrosive. Causes severe skin burns and eye damage. – Do not breathe mists into mouth. Avoid contact with skin and eyes. Wear protective gloves and clothing, eye and face protection when handling product. Always wash hands immediately after handling product containers or working on equipment used for application. If on skin: immediately remove all contaminated clothing and wash affected area with plenty of water for 15 – 20 minutes and / or until advised to stop by Poison Control Center advisor.
- **Eye irritation:** Corrosive. Causes serious eye damage – Wear eye and face protection. If in eyes: Rinse slowly and gently with water for 15 – 20 minutes. If present, remove contact lenses after the first 5 minutes and continue rinsing for the remainder of required rinse time. Immediately call a poison center or doctor for further instructions as necessary for treatment.

2) Environmental Hazards:

Environmental Fate Comparison – Background: AITC is similar in structure to methyl isothiocyanate (MITC), the active substance released from the soil fumigants metam sodium and metam potassium. In comparison to MITC, AITC has the following properties:

- **Volatility:** AITC is less volatile than MITC due to a higher boiling point and much lower vapor pressure. In fact, AITC has a vapor pressure similar to water at equal temperature. Therefore, as a result, AITC has better retention in soil where it has maximum pesticide activity and minimal risk of human toxicity.
- **Mobility:** AITC has a lower water solubility and higher log P than MITC so it will be less prone to leaching.
- **Hydrolytic and Photostability:** AITC is likely to have similar photostability in air, water and soil as MITC based on similar photolysis of the isothiocyanate group. Studies support that AITC is likely to have greater hydrolytic stability in water, most likely due to the potential of AITC to intra-molecularly rearrange to form a pseudo six membered ring.
- **Soil Stability:** AITC is less stable in soil than MITC, most likely because it is better retained in soil where it readily reacts with amines and thiols present in soil organic matter, proteins in the target pest species, and its own soil degradation products.

  The non-biological degradation of AITC in soil (i.e., reactions of AITC with amines and thiols including soil organic matter) might have positive effects such as enhancing soil organic matter and generating small molecules (e.g. allylamine) capable of supporting microbial growth and providing plant nutrients (e.g. ammoniacal nitrogen as anticipated from small amines in soil in the ammonification pathway.

3) Physical and Chemical Hazards:

Unusual Fire & Explosion Hazards: Do not inhale explosion and combustion gases which, at high temperatures may contain toxic substances such as COx, NOx, and/or SOx. Burning produces heavy smoke.

Hazardous Decomposition Products: May release irritating and toxic gases if ignited.

Hazardous Decomposition: If temperatures reach the flash-point for this product it may generate flammable gases on contact with elementary metals (alkalies and alkaline earth, alloys in powder or vapors) and powerful reducing agents. It may generate toxic gases on contact with oxidizing mineral acids and powerful oxidizing agents. It may ignite on contact with oxidizing mineral acids and powerful oxidizing agents.

Hazardous Polymerization: Does not occur.

DOMINUS® Description

1) The Right Choice for Pre-Plant Soil Treatment:

Producing a profitable crop always begins with the right choice.

DOMINUS® Soil Fumigant from ISAGRO USA is a new choice for growers needing broad spectrum control of agronomically important pests and disease. DOMINUS® meets the standards for pre-plant soil treatment efficacy and performance expected in today's marketplace.

DOMINUS® soil fumigant (Allyl Isothiocyanate) controls soil-borne pathogens, weeds, weed seeds, nematodes and insects. It has been developed for pre-plant fumigation of soils used to grow a wide variety of crops such as strawberries, fresh market tomatoes, peppers, melons, ginger, berries, cucurbits and ornamentals such as, turf and cut flowers or bulbs. DOMINUS® is patented and licensed exclusively to ISAGRO USA Corporation and its parent company Isagro SpA. Testing since 2009 has demonstrated equal or superior control of soil pests and diseases compared to other registered fumigants.

As a pre-plant soil treatment, DOMINUS® offers many value-added benefits including:

- US EPA Classification and registration as a biopesticide
- Application pending approval for use in organic production from National Organic Program (NOP) and Organic Materials Review Institute (OMRI)
- Multiple applications allowed per year
- No restrictions on maximum applied acres per day
- Application via conventional equipment (broadcast shank, raised bed shank, drip or probe/auger deep injection methods)
- Rapid breakdown in sun and UV light (< 1 day)
- When used as directed this product does not impact groundwater quality
- Does not leave a detectable residue of Allyl Isothiocyanate in the soil and is not transmitted to plants or food products

2) Composition:

DOMINUS® contains the active ingredient Allyl Isothiocyanate. DOMINUS® is a liquid at room temperature and formulated with 96% active and 4% inert ingredients. In DOMINUS®, the active ingredient has a detectable odor which also serves as its own warning odorant to aid in the detection of Allyl Isothiocyanate vapors. DOMINUS® is currently registered in the USA for pre-plant soil application and as an alternative to methyl bromide in soil fumigation.

Based on its physical and chemical characteristics, DOMINUS® can be applied via agricultural drip irrigation systems and directly to soil via tractor mounted soil injection equipment.

Active Ingredient	CAS Number	% Weight 96/4
Allyl Isothiocyanate (AITC)	57-06-7	96.30
Other Ingredient	Adjuvant/Surfactant	3.70

3) Physical-Chemical Properties:

	DOMINUS® Formulated Product
Appearance	Clear to light yellow
Odor	Pungent odor
Physical state	Liquid
pH	4.0 - 5.0
Boiling point	151°C
Melting point	-80°C
Vapor pressure	3.5 – 4 mm Hg, 1.33 kPa@38.3˚C
Vapor density (water = 1.0)	3.4
Specific gravity	1.0175 g/ml @ 25˚C
Odor Threshold	0.0074ppm to 0.15 ppm
Solubility	Slight, 2 g/L water @ 25˚C
Henry's Law Constant	2.752E-004 atm-m^3/mole
Flashpoint	47˚C
VOC rating	< 0.25 Ethane Threshold
Molecular weight	99.16
Viscosity	10˚C = 0.53 mPa – sec 30˚C=0.45 MPa – sec

Summary: Allyl Isothiocyanate Characteristics:

- Liquid, oily
- Does not mix readily with water, (note: an adjuvant is required when mixing with water for drip applied injection)
- Alkaline
- Toxic or noxious vapors/gas
- Vapor pressure is 4 mm Hg
- Vapors are 3.4 times heavier than air
- Liquid is not significantly heavier than water
- Produces insignificant pressure. (The majority of pressure in the cylinders is what is added as a nitrogen pad.)

4) Mode of Action:

The chemical mechanism by which Allyl Isothiocyanate controls various soil borne pathogens and pests is considered to be multi-site and classified as a general irritant and / or desiccant against target disease and pests.

Allyl Isothiocyanate enters a gas phase once injected into the soil using either drip irrigation systems or using tractor mounted shank injection. The gas then disperses through the soil pore spaces and finally into the atmosphere at low concentrations where it is rapidly broken down by ultraviolet (UV) light.

5) Product Compatibility: (Journal of the Food Hygienic Society Japan, Vol 36. No. 3, June 1995.)

Corrosive Effect of 3,000ppm AITC Vapor on Various Materials, 1 to 20 days)

Material	Compatibility	Comments
HDPE	Y	Appearance did not change with any formulation of DOMINUS®. No adsorption of DOMINUS® into HDPE material causing a weight increase of the HDPE. No change of hardness when HDPE is exposed to DOMINUS®.
Viton	Caution	Data pending
PTFE	Y	Appearance did not change with any formulation of DOMINUS®. No change in weight as a result of exposure to all formulations of DOMINUS® No change of hardness when PTFE is exposed to DOMINUS®.
PVC	Y	Appearance did not change with any formulation of DOMINUS® No change in weight as a result of exposure to all formulations of DOMINUS®.
Mild steel*	Y	Specimens exhibited no corrosion at extended time intervals. No change in weight as a result of exposure to all formulations of DOMINUS®.
Stainless Steel, 304 and 316	Y	Appearance did not change with any formulation of DOMINUS®. No change in weight as a result of exposure to all formulations of DOMINUS®.
Kalrez	Caution	Data pending
Tin	Y	Not effected at 3000 ppm vapor
Copper	Do Not Use	Literature states evidence of pitting and metal degradation, while no effect when exposed to vapor at 100ppm
Solder	Y	Not effected at 100ppm vapor, slight effect (surface whitening) at 3000ppm
Iron	Y	Not effected at 3000ppm
Nylon	Caution	Avoid contact with neat material as degradation may occur. Contact allowed only when product is diluted in water.
Aluminum, or their alloys	Y	Appearance did not change with any formulation of DOMINUS®. No change in weight as a result of exposure to all formulations of DOMINUS®. Not effected at 3000ppm
Brass	Caution	Literature reports that no degradation with use of these materials.
Neoprene, natural or butyl rubber	Caution	Laboratory testing and literature reports that no degradation with use of these materials. Slight to significant adsorption and loss of surface sheen. Neoprene showed slight to moderate softening.

** Results from ISAGRO USA conducted material compatibility study.*

DOMINUS® Dose Rates

DOMINUS® product and dose rates are listed in the attached table – please refer to product labels for the most recent information.

1) Broadcast Acre Application Rates For Pre-Plant Fumigation:

	%	Standard USA	Standard Rate PE and Highly Retentive Films (FP*)						Formulated Product	AITC in formulation
Product	Formulation	Rate HR Film (broadcast)	Gal/A	Actual Lbs/A	Lbs/ft2	Kg/Ha	L/m2	L/Ha	G/m2	G/m2
DOMINUS®	96	85	10.00	85.00	0.0020	95.25	0.0130	93.53	9.53	9.14
DOMINUS®	96	128	15.00	127.50	0.0029	142.88	0.0196	140.29	14.29	13.72
DOMINUS®	96	170	20.00	170.00	0.0039	190.51	0.0261	187.05	19.05	18.29
DOMINUS®	96	213	25.00	212.50	0.0049	238.13	0.0326	233.82	23.81	22.86
DOMINUS®	96	255	30.00	255.00	0.0059	285.76	0.0391	280.58	28.58	27.43
DOMINUS®	96	298	35.00	297.50	0.0068	333.39	0.0456	327.35	33.34	32.01
DOMINUS®	96	340	40.00	340.00	0.0078	381.02	0.0521	374.11	38.10	36.58

**FP = Formulated Product*

2) Application Rates for Raised Bed Fumigation:

Dose rates listed in fumigation tables ABOVE (for drip and raised bed shank applications) are given in weight or volume of DOMINUS® per Broadcast Acre. For raised bed fumigations, the amount applied, or Rate per Treated Acre will be proportional (percentage of the broadcast rate) to the row spacing and width of raised beds. To calculate the amount of product to be applied per treated acre, multiply the application rate in gallons or pounds of DOMINUS® broadcast per acre by the appropriate modifier from the Field Rate Modifier (FRM) table provided below.

Examples for determining Rate per Treated Acre:

- DOMINUS® @ 30 Gal/A broadcast x 0.65 (FRM) = 19.5 gallons actually applied
- DOMINUS® @ 255 Lbs/A broadcast x 0.65 (FRM) = 165.75 lbs actually applied

Field Rate Modifier (Treated Area) Table for Common Raised Bed Applications

Row Spacing (inches)	Bed Width (inches)	Field Rate Modified (Treated Area)
72	54	0.75
72	48	0.67
72	44	0.61
72	40	0.56
72	36	0.50
72	32	0.44
72	30	0.42
72	28	0.39
66	42	0.64
66	38	0.58
66	32	0.48
66	30	0.45
66	28	0.42
66	24	0.36
60	30	0.50
60	28	0.47
52	30	0.58
52	28	0.54
48	28	0.58
42	24	0.57

If the row spacing and bed width to be used do not appear in the table above, calculate the field rate modifier by dividing the average bed width (inches) by the row spacing (inches) as in the example below. The Field Rate Modifier is not to exceed 0.75.

How to determine Field Rate Modifier:

- Bed Width (in.) ÷ Row Spacing (in.) = % of Acre Treated
- (43” Beds ÷ 66” Row Spacing) = 0.65 conversion factor for Field Rate Modifier (FRM)

Product Storage

- Outdoor storage of DOMINUS® soil fumigant should be under ambient conditions and in a secure and locked area. Provide overhead protection of the cylinder storage area. Indoor storage of DOMINUS® soil fumigant should be under lock and key and in a well-ventilated area.
- All storage areas must be posted with appropriate warning signs for pesticides.
- Pesticide Disposal: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law.
- Return of Containers: This pesticide container, whether full or partially used, is the property of the manufacturer or distributor where it was purchased and must be returned to the distributor of origin. Do not ship containers without safety caps or if applicable valve protection bonnets. Containers shall never be refilled by the consumer/end user or reused for any other product or purpose.

Waste Disposal

- Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law.
- If the pesticide wastes cannot be disposed of by use according to label instructions, or at an approved waste disposal facility, refer to pesticide disposal statement on approved label. For additional information or guidance contact the State or Environmental Control Agency, or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.
- The pesticide container, whether full or partially used, is the property of the manufacturer or distributor where it was purchased and must be returned to the distributor of origin.
- Do not ship containers without safety caps or if applicable valve protection bonnets.

FOR MORE DETAILS PLEASE REFER TO THE TRAINING MANUAL FOR DOMINUS® STORAGE AND HANDLING

Transportation

Placard Descriptions:

Product Container - Labeling

1) General Requirements on Keg, Cylinder, IBC and ISO Tank Labeling:

DOMINUS® kegs, cylinder, IBC and ISO tanks must have:

- Registered label: the label approved by the authorities of the country is the only one which can be placed on each package type used for DOMINUS® transportation.
- Approval UN number
- ADR and hazard label

2) General Requirements for Hazard Labeling:

a. General specification for placards

Strength and durability. Placards must conform to the following:

- A placard may be made of any plastic, metal or other material capable of withstanding, without deterioration or a substantial reduction in effectiveness, a 30-day exposure to open weather conditions.
- A placard made of tag board must be at least equal to what is commercially designated as white tag board. Tag board must have a weight of at least 176 pounds (80 kg) per ream of 24- x 36-inch (610 x 910 mm) sheets, waterproofing materials included. In addition, each placard made of tag board must be able to pass a 60 psi (414 kappa) Mullen test.
- Reflective or retro reflective materials may be used on a placard if the prescribed colors, strength and durability are maintained.

b. Visibility and display of the placards

Each placard on a motor vehicle and each placard on a rail car must be clearly visible from the direction it faces, except from the direction of another transport vehicle or rail car to which the motor vehicle or rail car is coupled. This requirement may be met by the placards displayed on the freight containers or portable tanks loaded on a motor vehicle or rail car.

Each placard on a transport vehicle, bulk packaging or freight container must:

- Be securely attached;
- Be located clear of appurtenances and devices such as ladders, pipes, doors, and tarpaulins;
- So far as practicable, be located so that dirt or water is not directed to it from the wheels of the transport vehicle;
- Be located away from any markings (such as advertising) that could substantially reduce its effectiveness, and in any case at least 3 inches (7.60 cm) away from such markings;
- Have the words or identification number (when authorized) printed on it displayed horizontally, reading from left to right;
- Be maintained by the carrier in a condition so that the format, legibility, color, and visibility of the placard will not be substantially reduced due to damage, deterioration or clogging by dirt or other matter;
- Be affixed to a background of contrasting color, or must have a dotted or solid line outer border which contrasts with the background color.

CHAPTER 2:
DOMINUS® USER SAFETY INFORMATION

Hazard Identification

1) Hazards to Humans and Domestic Animals:

	DOMINUS® Formulated Product
Eye Contact	Vapors can cause irritation. Splashes may cause severe irritation with the potential to create permanent eye damage.
Skin Contact	Prolonged contact can cause severe irritation or related adverse skin effects.
Ingestion	Ingestion may damage the mouth, throat and/or gastrointestinal tract.
Inhalation	Inhalation of vapors can irritate the respiratory tract. If a person is not breathing call 9-1-1 immediately or an ambulance. Overexposure may produce symptoms of vertigo, delirium and mental disturbances. Other symptoms may include coughing, nausea and vomiting.

The hazard characteristics of DOMINUS® are detailed on the product label and should be understood by all persons responsible for the handling and / or application of this product.

Hazards to Humans and Domestic Animals: Signal Words: Danger, Corrosive

- Causes eye damage with possible irreversible impact without proper treatment. This product is considered to be a lachrymator.
- Corrosive to the skin.
- Causes skin irritation with potential for chemical burns.
- May be harmful or fatal if swallowed.
- Harmful if it is absorbed through the skin.
- Do not get in eyes, on skin or on clothing.
- Do not breath product vapors. Irritation to throat and mouth can occur with inhalation of vapors.
- Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

SPECIAL NOTE:
If this product is tank mixed with chloropicrin or other approved fumigants, the applied product must be considered a poisonous liquid or vapor, especially when mixed with chloropicrin or other toxic fumigants. When DOMINUS® is mixed with another fumigant the more stringent buffer zones and mitigation measures must be used. Inhalation of vapors may be fatal. Chloropicrin is readily identified by smell. Exposure to very low concentrations of vapor will cause irritation of eyes, nose and throat. Continued exposure after irritation is evident or higher concentrations may cause painful irritation to the eyes or temporary blindness. Liquid will cause chemical burns to skin or eyes. Do not get on skin, in eyes, or on clothing. Chloropicrin fumigant has the capacity to cause marked irritation to the upper respiratory tract and is a strong lachrymator (tear producing eye irritant). Low concentrations, below those necessary to cause serious systemic intoxication, are capable of causing severely painful eye irritation, hence will not be voluntarily tolerated. However, the effect may be so powerful that a person may become temporarily blinded and panic-stricken and that in turn may lead to accidents.

2) Environmental Hazards:

- Toxic to marine animals, birds and wildlife.
- Do not discharge into bodies of water without government approved permit(s).

3) Physical and Chemical Hazards:

- Do not use or store near heat, open flames or sparking electrical equipment.
- Do not allow contact with foams, copper or magnesium alloys.

First Aid Measures

	DOMINUS® Formulated Product
Eye Contact	After contact with the eyes, rinse with water or saline solution. If present, remove contact lenses after at least 5 minutes of rinsing then continue rinsing for another 10 - 15 minutes with the eyelids open. Consult an ophthalmologist immediately. Protect uninjured eye if only one eye is exposed to DOMINUS®.
Skin Contact	Immediately take off all contaminated clothing. Areas of the body that have - or are only suspected of having - come into contact with the product must be rinsed immediately with plenty of running water and soap. WARNING! This product is toxic through skin contact. OBTAIN IMMEDIATE MEDICAL ATTENTION for all prolonged or severe exposure to the chemical. Remove contaminated clothing immediately. If usable wash separate from normal laundry. If clothing is contaminated beyond use, dispose of properly and safely. Thoroughly wash those body parts thought to be exposed then proceed with a full body shower or bath.
Ingestion	Do NOT induce vomiting. Give nothing to eat or drink to an unconscious person. Have person sip a glass of water if able to swallow. Seek medical attention for further action as necessary to treat irritation to skin, nose or throat.
Inhalation	If breathing is irregular or stopped, administer artificial respiration. If a person is not breathing call 9-1-1 immediately or an ambulance. In case of inhalation, consult a doctor immediately and show him packing or label for proper treatment.

Note to Physician:
Probable mucosal damage may contraindicate the use of gastric lavage. Treatment is symptomatic. Symptoms of overexposure to AITC include irritation to eyes, skin, and respiratory system, shortness of breath, nausea, and vomiting.

Transport Incident

TABLE OF INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES FOR DOMINUS®

Small Spills (< 200L or 53 gallons)						Large Spills (> 200L or 53 gallons)					
First isolate in all directions:		Then protect persons downwind during -				First isolate in all directions:		Then protect persons downwind during -			
		Day		Night				Day		Night	
Meters	Feet	Km	Miles	Km	Miles	Meters	Feet	Km	Miles	Km	Miles
25	80	0.1	0.1	0.2	0.1	250	820	0.3	0.2	0.8	0.5

Procedures and actions in the event of a DOMINUS® involved incident

- Clear area of personnel and move upwind.
- Alert Emergency Responders and tell them location and nature of hazard.
- Observe and prevent conditions that may favor potential for the product to react explosively.
- Wear all label required PPE.
- Prevent, by any means available, spillage from entering drains or water course.
- Remove all workers and bystanders from the affected area to a place that is upwind and away from any potential exposure.
- Do NOT allow smoking, naked lights or ignition sources within close proximity to the incident.
- If indoors take necessary steps to increase ventilation and air mixing. Move all unnecessary persons to outdoors and upwind from incident site.
- If outdoors remove all unnecessary persons to a location away from and upwind of the incident site and take necessary precautions to perform clean-up and containment work upwind from spill.
- Take action to reduce and/or eliminate all leaks or spills if safe to do so.
- Overhead water spray/sprinklers may be used to reduce air concentrations.
- Contain or absorb spill by covering the area with sand, earth or vermiculite.
- Use only spark-free shovels and explosion proof equipment.
- Collect recoverable product into labeled containers for safe transport and handling away from the area.
- Collect all solid residues into seal-able labeled containers for proper disposal.
- Wash area with chemical detergent and water being sure to prevent runoff into drains and/or from expanding the incident area.
- After clean-up operations, dispose of all contaminated protective clothing and decontaminate all equipment if possible otherwise dispose of in accordance to all Federal and State regulations.

General Use Precautions

Always refer to product labels – general use precautions include the following:

- Follow all local government instructions for posting as per label requirements of treated areas with warning signs.
- Comply with all local ordinances and regulations.
- Do not apply within 30 m (100 feet) of Sensitive Sites that are defined as nursing homes, hospitals or prisons; or licensed schools, playgrounds; state licensed day care centers (any child care facility other than a family day care home, including infant centers, preschools, extended day care facilities and school age child care centers) or licensed assisted living facilities (licensed by state or local governments) that will be occupied during the 24 hour buffer zone period.
- Never fumigate alone. A minimum of two trained persons must be present during handling and application of soil fumigants. Additional instructions must be made available to handlers in the mechanical operation of the tractor/drip application equipment and how to safely work with the operator while fumigating.
- Always handle this product in the open, with all handlers positioned “upwind” from the container and/or where there is adequate ventilation.
- When fumigating, it is required that 20 liters (5 gallons) of water be carried on the tractor or near the drip application equipment and readily available for rinsing and cleaning purposes. An additional 20 liters of water must be available in the service truck. This water must be potable and in containers marked “Decontamination water not to be used for drinking”.
- For broadcast applications, keep all pets, livestock and other domestic animals out of the treated areas until tarps have been removed.
- For raised bed applications, keep all pets, livestock and other domestic animals out of the treated areas for 5 days. Most raised bed applications will not result in tarp removal.
- Do not allow entry by unprotected workers into the fumigated area until the Biofumigant Treated Area signs are removed and the entry restricted period is over.
- Applications are prohibited after sunset and before sunrise as wind speed conditions may be unfavorable.
- The uses of all films defined as low density polyethylene (LDPE), High Density polyethylene (HDPE), Virtually Impermeable Film (VIF) and Totally Impermeable Tarp (TIF) are allowed with DOMINUS under approved application methods. Check any local label restrictions and / or with your local ISAGRO USA representative for additional use recommendations of all tarp types.

Personal Protective Equipment (PPE) for DOMINUS®

Applicators, shovelers, tarp cutters and any other handler must wear, for their own safety, all the personal protective equipment (PPE) prescribed and mandated on the approved label per task.

1) Portable Gas Detection:

GAS DETECTION DURING HANDLING AND/OR USE OF AITC PRODUCTS

Note:
ISAGRO requires that at least one type of gas detection device with sufficiently low detection limits be readily available on-site when DOMINUS is being handled, applied or where there is the potential for liquid contact. The following devices may be used to detect AITC.

Each GASTEC Tube is intended for a single use to determine the concentration of AITC in the air space under the tarp or immediately above the tarp or soil. Follow all manufacturer instructions to properly handle the Gastec tubes. Although the GASTEC Tube is able to detect potentially dangerous levels of AITC from 5 to 200ppm,the GASTEC Tube detection limit of 5 parts per million (ppm) is insufficiently sensitive to reliably detect lower concentrations of AITC in the breathing space of a worker at a level of potential health concern (>2ppm). Therefore, when determining the concentration of AITC in the breathing space of a worker, another more sensitive device that can detect 2ppm or less, such as the Entry RAE monitor should be used.

Tube Data	
Tube Number:	149
Gastec Tube Name:	Methyl methacrylate
Chemical:	Allyl isothiocyanate
Range ppm:	5-200
Shelf Life (years):	2
Notes:	T

For production information and purchase of manual electronic detection devices contact:
Email Nextteq at info@nextteq.com or call us toll free at 877-312-2333 ext 20 for information on an authorized distributor in your area.

For use of the Entry Rae, Mini Rae or Toxi Rae type electronic gas detection devices contact:
RAE Systems Inc.
3775 N. First St., San Jose, CA 95134-1708 USA
Phone: +1.888.723.8823
Email: raesales@raesystems.com
Website: www.raesystems.com

Note:
An electronic device or other monitor capable of detecting AITC down to 2ppm or less must be present where workers handle or use AITC containing products

Any air detection device that has been used for any other fumigant will first need to be qualified and approved by ISAGRO USA before use with AITC containing products.

User notice: please refer to the technical data sheet for this device and its use directions and maintenance (see Appendix A)

2) Skin Protection:

a. Body protection

LOOSE FITTING or WELL VENTILATED LONG-SLEEVED SHIRT AND LONG PANTS ARE REQUIRED DURING APPLICATION/RE-ENTRY PROCESS, AND ALL OPERATIONS WHERE EXPOSURE TO DOMINUS® LIQUID CONCENTRATE IS POSSIBLE.

DOMINUS® is heavier than air; it can be trapped inside clothing. The wearing of protective coveralls will decrease this potential route of exposure.

Note:

- *ISAGRO USA requires the use of protective Tyvek® type coveralls or good quality cotton coveralls capable of covering the entire body and head. The use of a chemical apron is also recommended with activities that may enhance the potential for liquid contact*
- *Ensure that protective suits are the right size for all applicators.*
- *In the event of liquid contact with DOMINUS®, coveralls should be removed and replaced.*
- *Properly dispose of any clothing that is heavily soiled during fumigant handling and/or applications.*
- *Do not wash with other clothes.*
- *Wash all clothing in hot water using industrial soaps capable of cleaning solvents and/or oils.*

b. Hand Protection

GLOVES WITH CHEMICAL PROTECTION MADE of NITRILE, NEOPRENE, LATEX or RUBBER ARE REQUIRED DURING HANDLING, APPLICATION, EARLY ENTRY, TARP CUTTING AND ALL OPERATIONS WHERE EXPOSURE TO DOMINUS® LIQUID CONCENTRATE IS POSSIBLE.

The use of gloves for all activities where liquid contact is possible will prevent skin contact with DOMINUS®.

Note:
The gloves must be worn with Protective outerwear over field clothes or with a coverall/Tyvek® type sleeve over the cuff of the glove to avoid potential trapping of any fumigant vapors between skin and inner liner. Ensure that gloves are the right size for all applicators.

c. Foot Protection

CLOSED SHOES NOT MADE of ABSORBENT TYPE MATERIALS ALONG WITH SOCKS MUST BE WORN DURING THE HANDLING OF DOMINUS®, DURING APPLICATION AND WITHIN THE BUFFER ZONE.

The wearing of shoes prevents potential exposure to DOMINUS® and protects against mechanical injury while handling equipment.

Note:
The shoes are to be free of holes or tears and impermeable to liquid contact with skin in order to avoid the trapping of DOMINUS® between shoes and skin.

3) Respiratory Protection:

FULL FACE MASK or HALF FACE MASK IN COMBINATION WITH SAFETY GLASSES AND APPROVED CARTRIDGES TO PROTECT AGAINST AITC VAPORS MUST BE WORN AS NECESSARY DURING THE APPLICATION PROCESS, RE-ENTRY AND ALL OPERATIONS WHERE CONTACT WITH LIQUID DOMINUS® IS POSSIBLE AND/OR VAPORS CAN BE DETECTED

The use of properly fitting respiratory protection devices prevents potential inhalation of DOMINUS®.

"Respirators with an organic-vapor removing cartridge with pre-filter approved for pesticides must be available on site and provided to workers if sensory irritation occurs."

Whenever contact with liquid or vapors is a potential, all handlers (including mixers, loaders and applicators) in addition to the above listed PPE must wear an air purifying respirator with an organic-vapor removing cartridge with pre-filter approved for pesticides (MSHA.NIOSH approval number prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval number prefix TC14G) or a NIOSH approved respirator with organic vapor (OV) cartridge or canister with any N, R, P or HE pre-filter.

It is required that all respirator users be fit tested yearly and cleared by a medical practitioner prior to handling or working with DOMINUS. See OSHA guidelines 29CFR 1910.134 for respiratory protection that must be reviewed and complied with prior to use of respirators.

Medical considerations for potential users of DOMINUS®:
In the event that any medical issues prevent the handler/applicator from wearing a respirator, he or she is not allowed to apply DOMINUS® or work within the treatment area during application or restricted entry interval.

Do not wear respiratory protection if you have:

- Respiratory diseases like emphysema, asthma, skin allergies
- Circulatory problems (high blood pressure, heart disease)
- Psychological distress (claustrophobia, anxiety)
- Other problems affecting the sealing of the mask (i.e. beards or mustaches)

Other contraindications:
Having a beard is one of the biggest obstacles to adequate protection. A beard, even stubble, can compromise the performance of respiratory protection due to interference with the proper seal of the respirator. Wearers must be clean shaven prior to using the respirator.

Conditions for use of respirators:

- Do not store in an area where potential contamination can occur.
- When the respirator is not in use remove the cartridges and store in a Ziploc plastic bag or airtight container separate from the respirator.
- Clean and disinfect the respirator after each use with alcohol wipes and/or wash clean with soap and water.
- To ensure the upkeep and maintenance of personal protective equipment, maintain an equipment log to document the hours the cartridges are used. Replace cartridges and filters after a total of (8) hours use. Always replace cartridges and filters if they become damaged or if there is any odor detection when in use.
- Understand the value of respiratory protection but also its limitations.

Operating instructions:

- Discard and replace both filters at the same time. Ensure that both filters are of the same type and class.
- The effective life of a filter will vary depending on the level of contaminant, work rate exposure time, etc.
- To avoid heat exhaustion, it is also recommended not to wear the mask over a period exceeding 30 minutes at one time, especially if the wearer is in a greenhouse with temperatures exceeding 85°F and/or high humidity.

4) Eye Protection:

IF A HALF FACE MASK IN COMBINATION WITH SAFETY GLASSES IS WORN DURING THE APPLICATION/RE-ENTRY PROCESS, DO NOT USE GOGGLES WITHOUT SIDE VENTILATION TO AVOID THE POTENTIAL OF TRAPPING VAPORS INSIDE.

CONTACT LENSES SHOULD NOT BE WORN DURING FUMIGATION AS THEY MAY TRAP VAPORS BETWEEN THE LENS AND THE EYE CAUSING IRRITATION AND/OR DAMAGE.

TO AVOID POTENTIAL IRRITATION TO EYES AND THROAT, USE OF A FULL FACE RESPIRATOR IS RECOMMENDED DURING PRODUCT HANDLING AND WHERE THE POTENTIAL FOR LIQUID CONTACT IS POSSIBLE.

Note:
ISAGRO USA recommends on-site availability of a portable eye wash station with saline solution to be used in case of eye exposure. Eyewash should be used within the first 60 seconds of exposure to maximize its benefit.

5) Emergency Response:

TO ENSURE QUICK ACTION IN CASE OF EMERGENCY THE APPLICATOR IN CHARGE SHOULD HAVE A CELL PHONE WITH:

- FULLY CHARGED BATTERY

- EMERGENCY NUMBERS FOR FIRST RESPONDERS AND A LOCAL AMBULANCE SERVICE SHOULD BE STORED IN THE CELL PHONE MEMORY

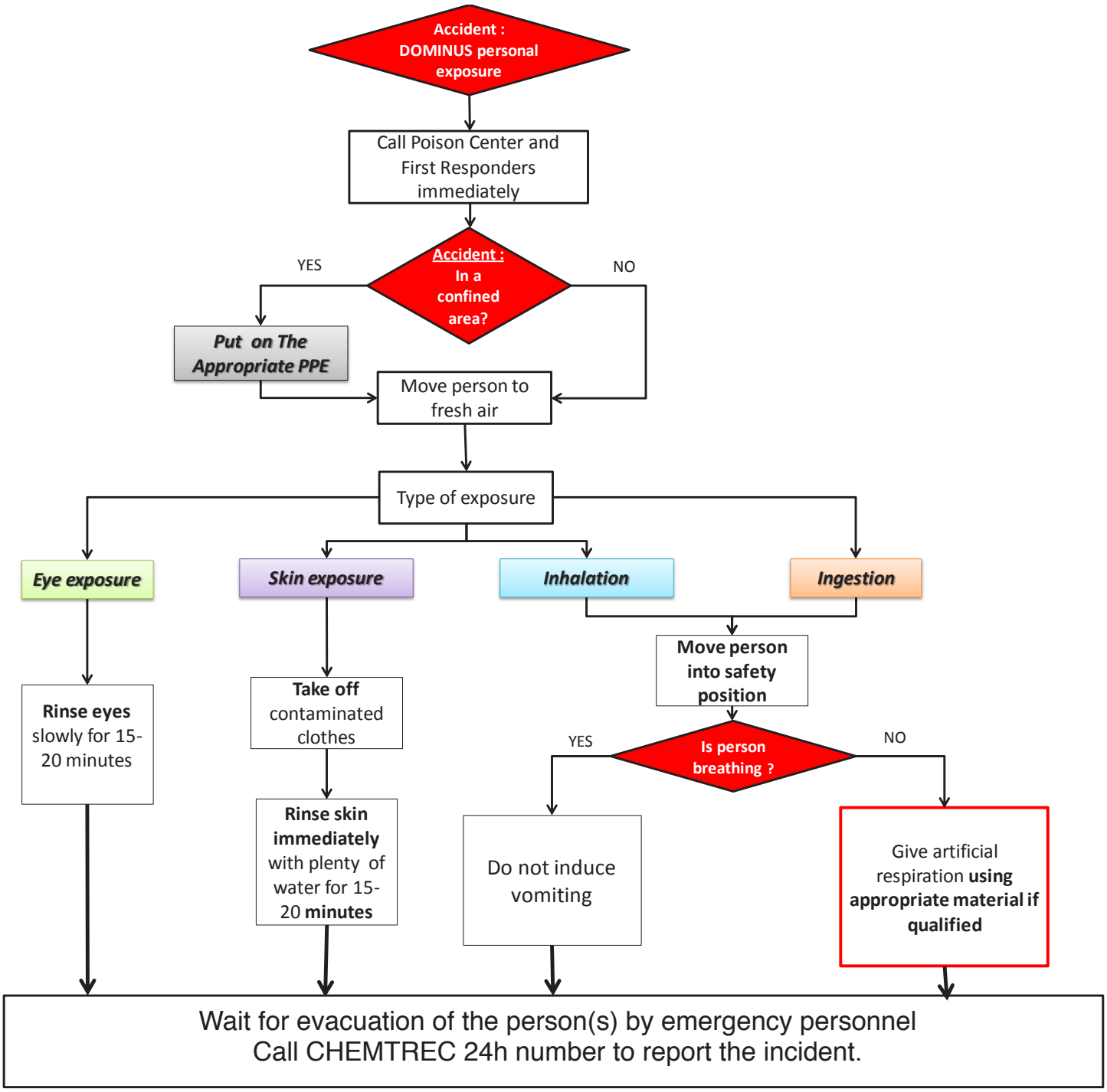
CHEMTREC for chemical spills and accidents

6) Basic PPE Requirements:

PPE (Always Refer to Product Label)	Anytime with Liquid Contact Potential	Start of Application until end of 48 hr Restricted Entry Period and in the Buffer Zone during the 24 hr Buffer Zone Period
Loose fitting or well-ventilated long sleeve shirt and long pants. Shoes plus socks.	Yes	Yes
Full face shield or safety glasses with brow, temple and side protection. Do NOT wear goggles without side ventilation	Yes	Yes
Chemical-resistant gloves, Chemical-resistant apron, chemical-resistant footwear, socks	Yes	Yes
Full face mask or half mask in combination with safety goggles with Approved cartridges for AITC	Yes	Readily available

IMPORTANT:
In emergencies such as a spill or leak or when corrective action is needed to reduce air concentrations to acceptable levels, wear a Self-Contained Breathing Apparatus (SCBA). In addition, wear PPE required for potential contact with a liquid fumigant. If no one on-site has been trained or certified in the use of SCBA and / or no SCBA is maintained on-site, contact the local fire department or emergency responder immediately. Have a copy of the Label and MSDS available at all times.

Additional protective measures may be necessary if at any time any user experiences sensory irritation of the eyes or nose or if air monitoring results detect persistent (i.e. ppm concentrations are determined to remain stable and not be reducing over a period of 15 minutes or more) and unacceptable levels of fumigant gas (>2 ppm). Immediately cease all activities and wear all PPE to inspect all equipment for any leaks and / or malfunctions. Do not continue use until all corrective actions have been taken to resolve the issue and AITC concentrations are determined to be <2ppm and/or undetectable by smell.


Accident : DOMINUS personal exposure
Call Poison Center and First Responders immediately
Accident : In a confined area?
YES
NO
Put on The Appropriate PPE
Move person to fresh air
Type of exposure
Eye exposure
Skin exposure
Inhalation
Ingestion
Rinse eyes slowly for 15-20 minutes
Take off contaminated clothes
Rinse skin immediately with plenty of water for 15-20 minutes
Move person into safety position
Is person breathing ?
YES
NO
Do not induce vomiting
Give artificial respiration using appropriate material if qualified
Wait for evacuation of the person(s) by emergency personnel
Call CHEMTREC 24h number to report the incident.

Call 9-1-1, ambulance and/or CHEMTREC @ 800-424-9300

ISAGRO Eastern Representative: 863-840-4600

ISAGRO Western Representative: 559-903-4653

Buffer Zone

1) Buffer Zone Definition:

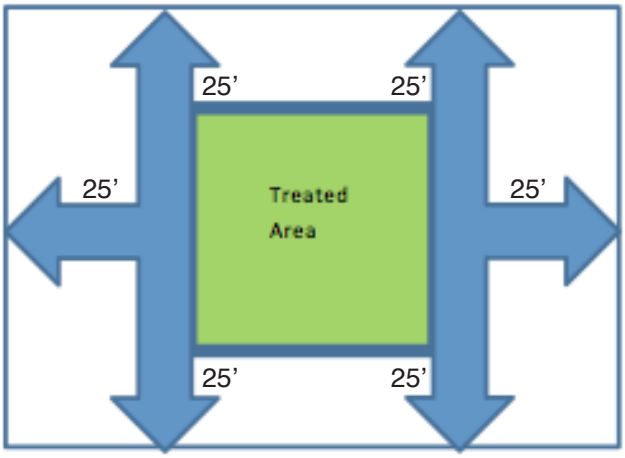
The buffer zone is the area adjacent to and surrounding the treated area. The buffer zone is to be extended from the edge of the treated area in all directions.

2) Buffer Zone Requirements:

Before applying DOMINUS® soil fumigant, the treatment area must comply with the following criteria:

- A 25' buffer zone is to be established from the edge of the treated area and any occupied structure that is NOT a Sensitive Site
- Sensitive site recommendation: Do not apply within 100 feet from the edge of the treated area to an occupied "sensitive site" such as:
  - Hospital,
  - Nursing home,
  - School,
  - Prison,
  - Day care facilities,
  - Playground.
- Do not apply if an occupied structure(s) is located within the buffer zone during the application or restricted entry interval.

Maintain 25 foot buffer zone from edge of Treated Area



The Supervising Applicator for the soil fumigation is responsible for the following:

- Ensure that the buffer zone is maintained from the start of the application until 24 hours following the end of the application.
  - Ensure the buffer zone is well secured to prevent disturbance from animals and to keep unauthorized (non-fumigant) persons from staying in the treated area and/or buffer zone during the buffer zone period.
  - Determining that the 25' mandated buffer zone is sufficient to secure safety for workers and bystanders. If deemed necessary, the supervising applicator may increase the buffer zone distance as an added measure of protection against accidental exposure or contamination.

- Buffer zones must be on the property where the treated area is located and must not include property that is not under the control of the supervising applicator unless written permission is obtained prior to fumigation. This includes the signature from the responsible party (-ies) from all property (-ies) that will be included or partially included in the buffer zone. Buffer zones shall not extend onto public roads or areas unless specifically allowed, or onto any other land for which written consent is not attainable. The supervising applicator must use appropriate means to manage and maintain the buffer zone such as posting Biofumigant warning signs around the perimeter of the buffer zone at potential points of entry, using trained workers to patrol the buffer zone, or other equivalent means. Biofumigant warning signs must be used, and must be posted from the start of the application until 24 hours after the end of the application. The signs must include the same warning symbol and statements required for notification warning signs with the exception that signs will indicate “Biofumigant Treated Area” at the top of the sign and will delete the statement “areas under fumigation”. “Biofumigant Treated Area” signs must be removed within 3 days of the end of the buffer zone period. Note: The “Buffer Zone Period” begins at the start of the application and lasts for a minimum of 24 hours after the application is complete.
- Ensure that unprotected workers and bystanders do not enter the buffer zone from the start of the application until 24 hours after the end of the application.
- Ensure that the buffer zone distance is at least 100 feet from occupied sensitive sites, e.g. nursing homes, hospitals, or prisons; and occupied schools, day care facilities and assisted living facilities.
- Conditions present at each individual treatment site should be considered when determining the most protective buffer zone distance and should include:
    - Presence and location of occupied structures
    - Wind direction and environmental conditions at the time of application and for a period 24 hours after the end of the application
    - Distance to sensitive sites
    - Activities of field workers near or adjacent to treatment areas during the first 24 hours post application

The Restricted Entry Period (REP)

Entry by any person, other than a correctly trained and PPE-equipped handler who is performing a handling task listed on the label is PROHIBITED from the start of the application until one of the following occurs:

- Treated area = 5 days or 120 hours from the end of the application
- Buffer Zone = 24 hours from the end of the application

It is important to also heed the Tarp Perforation and Removal section of the product label to determine requirements about when tarps are allowed to be perforated and/or removed. These requirements also affect the entry-restricted period, as well as appropriate PPE necessary to prevent any potential for exposure from the chemical treatment.

CHAPTER 3:
FACTORS AFFECTING FUMIGATION

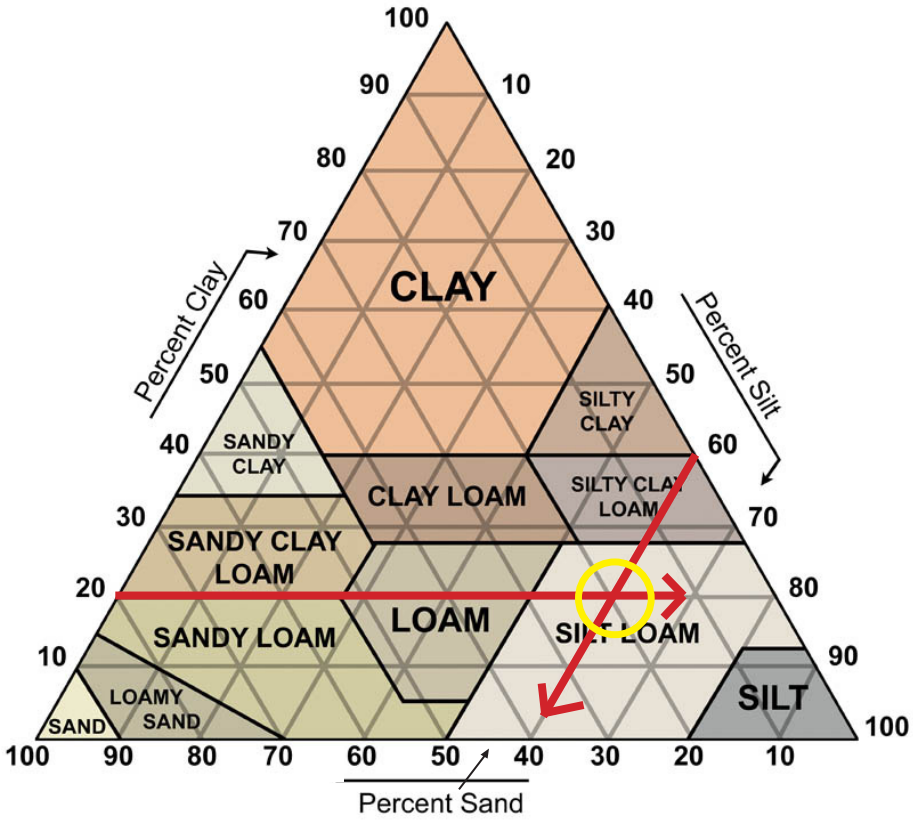
Under all conditions, the approved label recommendations must be followed. The guidelines in this document are provided as supplementary advice for users. If there is any discrepancy between the label language and these guidelines, the label instructions take precedence.

Soil Evaluation

1) Soil Type:

Soil must be properly prepared and at the surface generally be free of large clods. The area to be fumigated must be tilled to a depth of at least 5 inches below the soil/air interface.

The type of soil can be determined with use of the soil triangle below:



The soil texture triangle is used to classify the texture class of a soil. The sides of the soil texture triangle are scaled for the percentages of sand, silt, and clay.

Clay percentages are read from left to right across the triangle. Silt is read from the upper right to lower left. Sand from lower right towards the upper left portion of the triangle. The boundaries of the soil texture classes are inside the triangle. The intersection of the three sizes on the triangle gives the texture class.

For instance, if you have a soil with 20% clay, 60% silt, and 20% sand it is in the “silt loam” class.

2) Soil Moisture:

Do not apply DOMINUS® fumigant in wet or saturated soils. Apply irrigation as necessary to ensure a uniform moisture level in the fumigant zone (0 – 9" depth). Target % moisture that will allow weed seeds to swell, typically 12-15% but not more than 19% soil moisture or >60% Field Capacity (FC). Soil type must be considered when determining conditions for application in accordance with % soil moisture or FC. See examples below.

The feel and appearance method is a way of monitoring soil moisture to determine when and how much to irrigate.

a. Loamy fine and sandy soils

Appearance	Field capacity determined
Dry, loose, will hold together if not disturbed, loose sand grains on fingers with applied pressure.	0-25%
	25-50%
	50-75%
	75-100%

b. Sandy loam and fine sandy loam soils

Appearance	Field capacity determined
Dry, forms a very weak ball, aggregated soil grains break away easily from ball.	0-25%
	25-50%
	50-75%
	75-100%

c. Sandy clay loam, loam and silt loam soils

Appearance	Field capacity determined
Dry, soil aggregations break away easily, no staining on fingers, clods crumble with applied pressure.	0-25%
	25-50%
	50-75%
	75-100%

d. Clay, clay loam and silt clay loam soils

Appearance	Field capacity determined
Dry, soil aggregations separate easily, clods are hard to crumble with applied pressure.	0-25%
	25-50%
	50-75%
	75-100%

3) Soil Temperature:

DOMINUS® application is best recommended at soil temperature between > 60°F and r < 90°F at a depth of 8 inches. Chemical and physical characteristics of DOMINUS® application to soils outside the parameters will potentially limit proper dissipation of DOMINUS® in the soil profile and/or targeted area.

4) DOMINUS® Compatibility With Other Plant Protection Products:

Care should be taken with DOMINUS® and compatibility with other plant protection or fertilizer products having a high level of ammonia. The mixing of DOMINUS® with other fumigant or fertilizer products should first be determined to be compatible in the lab prior to mixing or use in the field. Consult your local ISAGRO USA representative for information and/or guidance on product compatibilities. Combining DOMINUS® with products of unknown compatibility could lead to human exposure or unforeseen environmental issues, as well as potential problems of crop injury/phytotoxicity for the succeeding crops. Formulators and/or applicators should request an explanation of the soil preparation practices prior to application of DOMINUS®.

Tarps and Films

It is important for applicators and growers to understand both the commonality and differences in various terms used for materials that cover soil in fumigated areas.

Terms such as “tarps”, “films” and “mulches” are used interchangeably, and ISAGRO USA uses all three terms to refer to coverings used in soil fumigant applications.

Traditionally, the term “tarp” has more often been used to describe broadcast or flat fume application sites, but the term “film” is also an acceptable equivalent. In the case of raised bed applications, the term “tarp” is used less frequently; and the term “film” is used more frequently. Lastly, the term “mulch” is exclusive to raised bed applications where the film is most often colored (white, black, red, silver, green etc…).

All of these films are variations of plastic layers bonded with polymers or nylon and may or may not be embossed. The use of embossing is a structural benefit exclusive to raised bed applications.

The injection of DOMINUS® soil fumigant that takes place under a plastic covering or tarp provides 4 benefits:

1. Increases the effectiveness of the product by preventing its dissipation and retaining it in the soil.
2. Increases the effective dose rate applied per treated area.
3. Reduces the potential risk of personal exposure because of lower air concentration.
4. Allows for greater regulation of soil temperature and/or moisture in the treated soil.

1) Type of Tarp:

Finally, the decision on which type of film to use may impact the emissions or flux (rate of vapor released through the plastic tarp over time), the application rate and planting interval after application as well as influence the efficacy against the targeted pests. The tarps, films or mulches come in two different categories as defined below:

1. Low Density Polyethylene (PE or LDPE): These can be single to multi-layer film with flux emissions typically >50%.
2. Highly Retentive Films (HRF) such as Virtually Impermeable Films (VIF) or Totally Impermeable Films (VIF): These are films with at least 2 layers of polyethylene bonded perpendicular to each other with a 3rd layer of polyamide, nylon or a 5 layer film with the composed 3 layers above plus 2 layers of adhesive resin. The 3 layer films are termed Virtually Impermeable Film (VIF) while the 5 layer films are defined as Totally Impermeable Films (TIF). The 3 to 7 layer films have a flux typically <25% emissions and significantly reduce peak emissions concentration compared to LDPE.

As a rule, follow the recommendations provided on the DOMINUS® label and use the guidelines listed below:

- All film types are allowed for all DOMINUS® applications.
- The use of TIF provides an increased margin of safety over all other film types, as well as potentially increasing product performance against target pests.
- Note that the potential presence of a higher concentration of product under the tarp when using TIF may impact the aeration time, especially under conditions where the soil may be cold (<60°F) or if soils are wet and / or saturated, in addition when ambient air temperatures are low, especially early or late season, these conditions may require longer than normal planting intervals.

Consult an ISAGRO USA representative as needed for further recommendations prior to planting with any questions regarding use of plastic films, aeration and planting intervals.

2) Good Sealing of the Tarp:

Before beginning and after any fumigant application, ensuring that the tarps are suitable barriers for fumigant emissions means

- No holes are present,
- No tears are present,

- A tight fit on the raised bed surface with ends and edges sufficiently buried with soil,
- And, in the case of broadcast applications that the glue is sufficient to hold the seams together between two tarp edges.
- In the event of tarp holes/tears needing repair, first wear all PPE to inspect and repair the area affected. Inspect tarps following application and routinely during the 5 day REP for any holes, tears and repair with tape (if less than 3' in length) or by placing a new section of plastic tarp over the torn area and ensuring the new tarp edges are buried in the soil and seams of the new plastic are taped to the existing plastic beyond the impacted area.

Weather Conditions

Note:
National Weather Service Forecasts should be checked by the supervising applicator prior to the start of the application. Forecasts for the local weather conditions can be found at http://www.nws.noaa.gov.

1) Temperature Inversion:

Temperature inversion is a phenomenon whereby cold air, which is heavier, accumulates near the ground and then is present under a layer of warm air. This can cause an abnormal accumulation of DOMINUS® at or near the surface of the soil and above the tarp. Under these conditions the air mass containing DOMINUS® may move off-site in unpredictable directions.

DOMINUS® cannot be applied in the presence of a persistent temperature inversion.

2) Wind Force:

The application of DOMINUS® requires a wind speed greater than 2 miles/hour. This minimum wind speed will allow for mixing of air within the treated area. The measurement of wind speed can be done with use of an anemometer. It is equally important to identify and determine the prevailing wind direction in the field and to take necessary actions to protect against exposure from potential downwind movement of DOMINUS®.

3) Fog:

Do not apply DOMINUS® in the presence of persistent ground fog or if it is likely to occur, as this may result in product being concentrated in water vapors within the fog layer and cause potential drifting of DOMINUS® outside the treated and buffer zone areas.

4) Rainfall:

Rainfall within a 12 hour period prior to fumigation should be considered due its effect on soil moisture and/or accumulation on the soil surface prior to fumigation for open field applications. In the case of raised bed applications, rainfall that accumulates in the furrows of raised beds can sub or create saturation along the edges of the beds and reduce the movement of gas vapors to effectively treat the edges or shoulders of the beds. Consult local weather conditions for the period 12 hours before fumigation and 24 hours post fumigation when fumigating open fields.

Irrigation System Considerations

1) Drip Line Considerations:

On raised bed drip applications, ensure that tubing size, drip emitter spacing and spacing between drip lines are sufficient to cover the fumigant area evenly and without over-saturation. Follow label instructions for emitter spacing and procedures and/or restrictions regarding sources of water that can be used to connect to injection devices, as well as, use of back flow/check valve prevention devices.

The number of drip lines, depth (<1.5" typically) and spacing of each drip line has the capability to treat a depth of 8 – 10" and width of 6" – 8" on each side depending upon soil type and moisture conditions.

2) Drip Emitter Checking:

Always check irrigation lines for leaks that can create flooding or reduced fumigant movement prior to application. Leaks in the irrigation system can lead to a misapplication of the product and thus reduce the effectiveness of DOMINUS® in the target area. To avoid this, you must first test the irrigation system. This action ensures there are no leaks and that all the irrigation valves of the treated area are able to deliver the product to the treated area at the desired rate of application with equal distribution.

Prior to beginning DOMINUS® injection, ensure that all leaks and/or breaks in the drip lines and all possible clogging of drip emitters have been repaired. Routine inspection of the drip lines and emitters is necessary throughout the injection time. At all times workers must wear appropriate PPE and perform repair tasks with personal safety first. It is possible that even simple repairs may require the need to halt the application until the repair can be sufficiently resolved.

3) Irrigation System Compatibility with DOMINUS® Product:

DOMINUS® soil fumigant is applied in a diluted concentration with irrigation water. As such, use of materials constructed with polyvinyl-chloride (PVC), polyethylene, (PE) and/or metal pipe can be used in the irrigation system Do not apply DOMINUS® in pipes constructed with clay or porous materials where fumigant can be trapped, adsorbed and / or not successfully purged from the system.

DO NOT APPLY DOMINUS® IN PIPE OR IRRIGATION LINES THAT MAY COME IN CONTACT WITH DRINKING WATER SUPPLIES OR NON-TARGETED AREAS. THE SYSTEM MUST CONTAIN A FUNCTIONAL SYSTEM COMPRISED OF A CHECK VALVE, VACUUM RELIEF VALVE, INSPECTION PORT AND LOW PRESSURE DRAIN APPROPRIATELY LOCATED ON THE IRRIGATION PIPELINE TO PREVENT WATER SOURCE CONTAMINATION FROM BACK FLOW.

Product Compatibility with Application Equipment

Please refer to Chapter 1 – Product Description, Section 5 Product Compatibility in this manual.

DOMINUS®

APPLICATION METHODS

CHAPTER 4: APPLICATION EQUIPMENT CALIBRATION AND SETTING

Application Equipment General Information

- Refer to product labels for specific equipment and maintenance requirements for both drip and shank applied products..
- DOMINUS® is sold in 1000 liter Industrial Bulk Containers (IBC), steel lined drums or US DOT approved mild steel cylinders. Do not transfer the contents to any other container before use.
- DOMINUS® must be removed from the IBC and steel drums with use of a closed system pumping system. Under no circumstances is DOMINUS® to be removed by pouring from the container where the contents would be subjected to open air.
- DOMINUS® must be removed from US DOT mild steel cylinders by introducing compressed nitrogen gas via the pressurization port of the cylinder.
- Maintain a functional check valve at the outlet of the nitrogen or inert gas regulator to prevent contamination of the regulator and the propellant tank.
- Liquid DOMINUS® must be delivered through a flow meter and a rate control device, flow divider or manifold via proper hoses.
- Use only plumbing materials made of brass, stainless steel, Teflon or polyethylene.
- Never use magnesium or copper.
- Replace all frayed or broken hoses.
- Check packing on all ball valves. Replace if worn.
- Replace chisels if fumigant tube (steel tubing welded to the backside of a shank) is worn or damaged.
- Test for leaks by pressurizing the application equipment with inert or compressed gas. Spray all connections with soapy water solution. Repair all leaks before beginning the application.
- Frequently monitor and verify proper flow meter output.
- The use of DOMINUS® may require modifications to the application equipment to ensure proper distribution to each chisel due to small volumes used per treated area. Consult your supplier to insure that the proper modifications have been completed on your application equipment before you begin the application.

Shank Application Equipment

- It is required that older flow meters be re-calibrated to verify flow accuracy and fit before use with DOMINUS®.
- Only minor modifications to the flow divider system should be necessary and these modifications will be dependent upon the nature and capacities of the existing equipment.
- Use only with inert gaseous propellants, such as nitrogen or compressed air (dry).

- DOMINUS® does not readily boil and make its own back-pressure as it passes through equipment and into the soil. The boiling point of AITC is between 298 - 309°F (148 – 154°C).
- DOMINUS® will be used at rates similar to conventional fumigant products, however the product density is much lower and flow meter size and calibration may need to be adjusted prior to use.
- Care in preventing drips from shank ends must be addressed with use of check valves or similar devices.
- All lines must be long enough to equilibrate pressure and equal length to ensure equal flow of DOMINUS® to each shank.
- Uneven flow to one or more shanks in a raised bed application will result in erratic control of disease and pests.
- Calibration and inspection of the delivery system is necessary prior to application to correct any potential problems with product distribution.
- Calibration worksheets provided (see below) are designed to allow the applicator to set up the application equipment to deliver DOMINUS® properly to the treated area.
- The use of DOMINUS® requires equipment evaluation to assure that each applicator can correctly apply DOMINUS® with the proper application equipment. Utilize the following procedure to evaluate current application equipment capabilities. Make changes necessary prior to beginning any DOMINUS® application.

DOMINUS® Shank Equipment Calibration Instructions

The following are specific instructions for the use of the DOMINUS® Calibration Form provided as an Excel™ spreadsheet. Calibration is accomplished by a calculation of ground speed. Never attempt to monitor the outflow of the application equipment to determine the amount applied. A check of the equipment setting can be obtained by measuring the amount of area covered by a cylinder with a known beginning and ending weight.

1) Instructions:

Step 1	Measure and mark 100 feet (31 m) of a row in the field where you will be making the application.
Step 2	Drive the tractor past this measured section at the speed you desire to make the application. The applicator must engage the soil just as it will during the application, but do not turn on the fumigant valve.
Step 3	Record the time required to travel the measured distance. Never use the tractor speedometer as it does not adjust for wheel slippage and may not provide an accurate reading.
Step 4	Measure the treatment width and convert it to feet.
Step 5	Determine the broadcast rate for the formulation of DOMINUS® that you are using by consulting the label. *This formula utilizes the broadcast rate even though you may be making a bed treatment because it only calculates the portion of the area you are treating.*

Step 6	Determine the flow meter that is being used on your applicator. Find its capacity in gallons per minute for the formulation you are using. • *If your application is a solid tarp application, your net broadcast rate should be verified by measuring the distance treated by each container. The actual amount applied should correspond closely to the broadcast rate you selected from the label. If your actual rate varies unacceptably, re-time your speed and verify your calculations. Also consult your distributor to verify the correct output of the flow meter.* • *If your application is a bed fumigation where you are treating only a portion of the soil surface, you should calculate your net usage:* o *Divide the bed width by the row spacing (measurement from the center of one row to the center of the adjoining row) to calculate the portion of the soil surface you are treating.* o *The percentage of the soil surface treated times the broadcast rate calculates the net usage per acre.*

As above, you should verify your actual application rate by measuring the distance treated by each cylinder.

- The difference in product density may require a change in flow meter type other than what has been used for conventional fumigants.
- Flow meters are accurate only if operated between 15 and 85% of their capacity.
- The DOMINUS® Calibration form (Excel™ sheet) is included as part of this document to assist you in calculating the flow meter setting for a DOMINUS® application.
- Take care to use the proper capacity rating for each flow meter.
- If the resulting calculation is less than a 15% setting on the flow meter or flow meter is worn, we recommend substituting a smaller or newer flow meter for the DOMINUS® application.
- Flow meters are typically calibrated with water and not to the specific gravity of fumigants. A range of flow meters are available but will only allow up to 100% of flow rate typically in the range of 0.33 to 4.16 GPM (1.25 to 15.60 LPM) AITC formulations
    - Prior to calibration of a flow meter, first determine whether or not it is designed for water and the maximum 100% flow capacity of the meter.
    - The flow meter capacity / flow rate is located on the face plate of the flow meter with a corresponding Float Code number
    - Float codes for use with AITC formulations are of the series numbers 706, 708, 710, 712, or 714.

Refer to the following chart to determine if a good fit exists to target flow percent volume per minute.

Note:
Application flow rate delivery is dependent upon tractor speed. The tractor speed can be variable based on type and size of plastic, broadcast vs. raised bed and formulation. These factors must be considered when choosing the best flow meter size and float code to deliver accuracy in fumigant applications.

BROADCAST/SHANK EQUIPMENT ONLY

Flow Units= Gallons per Minute (GPM)

Fluid	Water	100% Methyl Bromide	50% Methyl Bromide	DOMINUS® 96% AITC
Kg/L	1.00	1.73	1.67	1.02
Sp Gr	1.00	1.73	1.67	1.02
Float Code	**GPM**	**GPM**	**GPM**	**GPM**
706	0.55	0.32	0.33	0.54
708	1.10	0.64	0.66	1.08
710	2.00	1.16	1.20	1.96
712	4.00	2.31	2.40	3.92
714	6.00	3.47	3.59	5.88

Target flow meter settings are determined by tractor speed trials and are to be the average of 3 consecutive passes within +/- 5% of target speed. The average speed is then inserted into the following table (Excel sheet) along with # of shanks and shank spacing, target rate and flow meter (GPM). These data will be used to calculate a theoretical flow meter setting.

Consult your distributor for information on any other flow meter types you may have.

ENTER VALUES IN GREEN COLORED CELLS ONLY								
Time to cover 31m (100')		20.00	sec					
Broadcast Treatment Width								
	# shanks	12	x	shank spacing	12.00	inches	11.00	feet
Broadcast rate								
DOMINUS	96	30	gal/A	(Insert from DOMINUS Rates Table)				
MB Flowmeter Capacity		0.66	GPM					
DOMINUS Flowmeter		1.08	GPM	Equivalent from Table Above				
Enter Values in green cells ONLY								
Formula:								
1	60	sec/min	0.65	ft/s	93.00	ft/min		
2	93.00	m/min x	11.00	trt width ft	1023	ft 2/min		
3	1023	FT/min ÷	43560	ft2/A	0.023485	Acre/min		
4	0.02348485	Acre/min x	30	GPA	0.704545	Gal/Min		
5	0.70454545	Gal/min ÷	1.08	DOMINUS GPM Flowmeter	**65.24**	Target % Flow Meter Setting		
	NOTE: A target % flow meter setting that is less than 15% or greater than 85%							
	is out of range and will require a different size flow meter not listed above							

2) Filtration Device:

Use of filters in line with the system will help support even flow of product from containers to the shank end. Filters can be made of inert materials (stainless steel, polyethylene, and / or glass wool). Avoid if possible, mild steel or plastics, PVC and rubber “o” rings as they may not be durable for long term use and/or may become brittle.

3) Fumigant Delivery to Start a Row:

The reduced density and the lower volatility of DOMINUS® may present a challenge to achieve an adequate delivery at the beginning of each row. At the end of the previous pass all hoses and manifold forward of the on/off valve become void of fumigant due to gravity and the Venturi effect of the chisel being pulled through the soil. Care must be taken when starting the next pass to achieve full flow of the system before proceeding down the row.

We recommend the manifold system for DOMINUS® be constructed using the following criteria. This method will assure a full flow and an even distribution for the entire pass.

1. Use a manifold with sufficient outlets for each chisel (See photo example below). Mount the manifold in a secure, level position and as close to the center of the application machine as possible.
2. Add an additional filter equipped with a 50 or a 100 mesh screen at the inlet of the manifold to insure that the small yellow tubes remain open and delivering fumigant. Do not eliminate the standard filter in the system. Use this filter as a secondary filter.
3. The fumigant path from the on/off valve to the chisels should be as short as possible to minimize the fill requirements at each row start. To minimize the fill requirements we recommend an electric ball valve be used as the on/off valve and be mounted at the inlet of the new filter and the manifold.
4. Adjust tubing size to match the desired output of material while maintaining even flow to each shank end. Because DOMINUS® is close to the same density as water the flow can be first checked with water or similar product density, i.e. light oil (linseed oil). Note that to help ensure flow delivery tubing length must be equal and of a minimum length, typically in the range of 3’ – 9’ for in line pressure equilibration.
5. Equip the manifold with a good quality pressure gauge mounted on an extension pipe so that the driver can easily view the gauge. This allows the driver to monitor the manifold system operation.
6. We recommend individual site glasses for each chisel be used on the manifold to monitor for uniform delivery.
7. Do not tightly coil the tubing. The coil will increase the resistance to flow and reduce the capacity of the tube.

In line site glasses on flow divider

Output for single shank line

In line site glasses on flow divider

4) Fumigant Rig Operation at the Beginning of a Row:

In order to achieve a sufficient delivery at the start of the row give the driver the following instructions.

1. Begin by lowering the bed press and driving forward until the chisels are covered with soil and/or until the chisels are at the point where the row will start and stop the tractor.
2. Turn on the fumigant flow and confirm presence in all site glasses (flow meter and divider/manifold).
3. Wait to start the forward progress of the tractor (typically 3 – 5 seconds) until the flow meter percent is steady and the manifold pressure gauge begins to rise from zero. As the tractor gains speed full flow will be achieved and full delivery will be achieved at the start of the row.

Normal operation of the fumigant application system will generate approximately the same pressure on the manifold pressure gauge each pass. Should this pressure rise above its normal reading, the green, red or yellow tubes should be checked to assure that all are open and delivering fumigant.

5) Prior to Leaving the Injection Site:

Once application has been done, the site must be secured to ensure that no unauthorized people will enter the buffer zone area or inside the treated area.

Not respecting any or all of these requirements will increase the potential of personal exposure to humans and/or the environment with DOMINUS® soil fumigant.

Before leaving the site ensure that:

- All entrances are adequately placarded to inform and prevent access by unauthorized personnel.
- Warning tape if used is properly installed.
- Warning placards (see below) are in place and:
  - Completed with all the required information:
    - o Date of application,
    - o Date and hour of Re-Entry (5 days or 120 hrs from the end of the application),
    - o Contact name and phone number of the supervising applicator,
    - o Additional contact information phone number if required by local regulatory agencies.
  - Posted at all entrances or access points to the treated area as necessary to inform and prevent access.

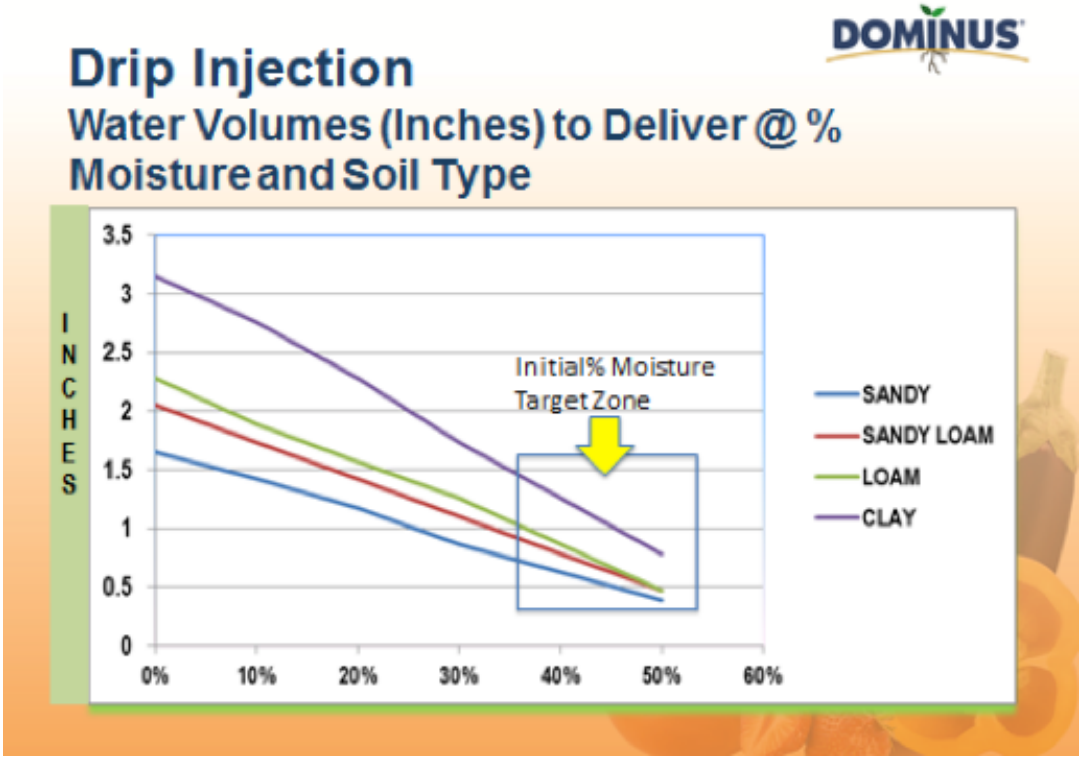
Drip Application Equipment

1) Introduction:

DOMINUS® is approved for application by drip injection. Typically a drip injection system allows mixing and injecting of 1 or 2 different products. For the purposes of this manual, DOMINUS® will be applied alone and directly into the irrigation system at a predetermined and prescribed concentration (ppm). Injection of DOMINUS® with another fumigant product is not prohibited but for the purposes of this manual the details are specific to the physical and chemical properties of DOMINUS®. Care must be taken if this product is co-injected with another fumigant product to ensure compatibility, concentration and delivery in the system is accurate. In addition the safety and use recommendations will be determined by the product having the most protective requirements and regulatory restrictions.

The quantity of product applied is defined by the user prior to injection and based on several known factors (soil type, water flow, drip tape type and emitter flow rate) to reach the desired pest and disease control in the treatment area.

2) Equipment Use and Determination:

Step 1	**Determination of the amount of water to be brought during the application process (Wetting phase, Delivery of DOMINUS®, Flushing phase)** a. Determination of the soil type (see Chapter 3 for selection of soil type) b. Determination of the initial soil moisture c. Use the diagram below to get an estimation of quantity of water to be applied during the application process  *Diagram 1: Determination of the water to be applied depending on type of soil and initial moisture* ***Example:*** *Soil type: Sandy – Initial Moisture 40% - Total quantity of water to be applied indicated on the diagram is 0.60 inches.*
Step 2	**Calculation of the total treated area:** Treated area = numbers of beds * length of the drip line * width of the beds *For broadcast application number of beds is equal to one*
Step 3	**Calculation of the quantity of DOMINUS® to be applied during the application:** Quantity of DOMINUS® to be applied (gal) = Dose Rate (gpa) x Treated area (acres)

Step 4	**Calculation of the quantity of water to be applied during the application process (Wetting phase, Delivery of DOMINUS® and Flushing phase):** a. Determinate the flow rate of the water into your main irrigation line. Value shown by the flow meter is ft^3/hour. b. Convert the read flow meter into gal/minutes Water flow rate (gal/min) = Water flow rate read (ft^3/hour) X 1000 / 60 c. Calculate the total quantity of water to be applied Total qty water (gal) =height of water established via diagram 1 (inch) x area (ft^2)
Step 5	**Calculation of the quantity of water to flush the irrigation system** Parameters from Irrigation system needed : • Diameter of the main irrigation line • Length of the main irrigation lines; • Number of drip lines, • Length of the drip lines, • Diameter of the drip lines in the soil bed *To ensure a complete flushing of the irrigation system after DOMINUS® product application; rinse your System 5X the amount of water to fill the irrigation system.* **Quantity of water for flushing (gal)** = [length main line 1(ft) x (diameter main line 1(inches))² x π/4000 + length main line 2 (ft) x (diameter main line 2(inches)² x π/4000 + length main line 3(ft) x (diameter main line 3(inches))² x π/4000 + number drip lines x length lines (ft) x diameter drip lines (inches)² x π/4000]*5
Step 6	**Calculation of the flow of the emitters** Estimated emitter flow = Water Flow (ft^3/h) X 1000/(number drip lines x length drip lines (ft) / space between emitters (ft))
Step 7	**Calculation of the quantity of water to deliver during the flushing of the irrigation system** Quantity of water brought during wetting phase (gal) = (flow rate of water (gal/min) X Time for wetting phase (min) *Time for the wetting phase is determined by taking into account the initial soil moisture.*
Step 8	**Calculation of the quantity of water to deliver during the injection phase:** Quantity of water to bring during injection phase (gal) = Quantity total of water during application (gal) - Quantity of water for wetting phase (gal) - Quantity of water for flushing phase (gal)
Step 9	**Calculation of the height of water to be bring during Injection Phase** Height of water to apply during injection (inches)= quantity of water to bring during injection (gal)/ treated area (ft^2)

Step 10	**Calculation of DOMINUS® injection dilution** Dilution Obtained = (Dose Rate x Area) / (quantity of water applied during injection step)
DOMINUS® Rate Calculator[1] form (Excel sheet) is included as part of this document to assist you in calculating the requirements for a DOMINUS® application	

3) DOMINUS® Product Injection:

Always wear label required PPE during handling and when connecting the DOMINUS® container to the drip injection equipment or system.

a. Equipment leaks inspection

Prior to starting DOMINUS® drip injection, always check if leaks are present and that the equipment is in optimal working order. Begin with pressurizing the system with clean water and inspecting all areas where a connection is made (i.e. injection point, cylinder connection,etc.) Use a solution of soapy water to verify that all connections are secure and without leaks.

b. Beginning of injection

A supervising applicator must always be on site during the injection. Refer to the product label for use and product handling. Prior to application the ISAGRO USA drip injection calculator should be used to verify that all product and water delivery calculations are accurate and meet the physical parameters of the treated site for amount of water to deliver as per soil type, distribution, and ppm concentration in the irrigation water.

c. Ending of injection

After the injection, disconnect all application equipment, wearing all PPE defined on the product label and recommended by ISAGRO USA.

Rinse the irrigation system using the volume calculated by the Rate Calculator.

d. Prior to leaving the injection site

Once the application is complete, the site must be secured to ensure that no unauthorized people will enter the buffer zone area and into the treated area.

Not respecting any or all of these requirements will increase the potential of personal exposure to humans and/or the environment with DOMINUS® soil fumigant.

Before leaving the site ensure that:

- **Biofumigant Warning** placards (see below) are in place and:
  - Completed with all the required information:
    - o Date of application,
    - o Date of Re-Entry Period (5 days or 120 hrs from the end of the application)
    - o Contact name and phone number of the supervising applicator
    - o Additional Contact information phone number if required by local regulatory agencies

- Posted at all entrances or access points to the treated area as necessary to inform and prevent access.

DANGER PESTICIDES

PELIGRO PESTICIDAS

Areas Under Fumigation

Company Name:
Biofumigant In Use: **DOMINUS®** (Allyl Isothiocyanate)
Date: / / Time: : am / pm
Restricted period is over: / / @ : am / pm
Supervising Applicator Contact:
Address:
Telephone:
EMERGENCY TELEPHONE NUMBERS: Day: Night:

FOR SPILLS OR TRANSPORTATION EMERGENCIES:
800-424-9300 (Chemtrec)

DO NOT ENTER
NO ENTRE

DOMINUS- Trial Plot Calculator					ENGLISH UNITS	ENTER INTO CLEAR CELLS ONLY					
FARM :				Application Date	8/16/2013						
FT2/ACRE	43560			Applicator:							
ML/GAL	3785										
TREATMENT AREA				**TRT LIST**	**PRODUCT**	**RATE FP**	**UOM**	**RATE**	**UOM**	**LBS/GAL FP**	
BED	INCHES	FEET		1	UTC	NA	NA	NA	NA	NA	
TOP	56	4.67		2	DOMINUS	255	LBS/A	30	GPA	8.5	
On Center BASE	56	4.666667		3	DOMINUS	340	LBS/A	40	GPA	8.5	
AVE	56	**4.67**		4	PIC-CHLOR 60	350	LBS/A	29.6	GPA	11.81	
				5							
REP											
# Beds /TRT		33									
DRIP LINES PER BED		2									
LENGTH'		250		16500	TOTAL TRT (L)						
WIDTH'		4.67									
TOTAL FT2/REP		1166.67									
TOTAL FT2/TRT		**38500.00**									
ACRES/TRT		0.8838									
PRODUCT QUANTITIES	TRT #										
DOMINUS	2										
LBS/ TRT	225.379										
ML/TRT	**100359.85**										
GAL/TRT	26.515152										
DOMINUS	3										
LBS/ TRT	300.505										
ML/TRT	**133813.13**										
GAL/TRT	35.353535										
PIC-CHLOR 60	4										
LBS/ TRT	309.343										
ML/TRT	**99141.82**										
GAL/TRT	26.193348										
IRF135- 10 Gal Mix	3										
LBS/TRT	85										
ML/TRT	37850										
GAL/TRT	10										

DOMINUS - FLOW CALCULATIONS									
Farm:			ENGLISH UNITS						
FT2/ACRE	43560		TARGET INCHES	0.65					
ML/GAL	3785		TARGET PPM MIN	2,531.34					
ACRE' WATER	325,848	GAL	FLUSH TIME	45	MIN				
ACRE" WATER	27,154	GAL	TOTAL WATER	17,650	GAL				
			FLUSH VOL	1,633.50	GAL				
DRIP TAPE - Water Volumes									
TOTAL TRT ' (L)	16500								
DRIP TAPE FLOW	0.33		GAL/MIN/100'						
TOTAL GAL/MIN/TRT	**54.45**								
TOTAL ML/MIN/TRT	206093								
GAL WATER / TRT									
FLUSH VOLUME	1633.5		GAL						
WATER/TRT	**13,966.34**		GAL						
TRT WATER and FLUSH	**15,599.84**		GAL						
TIME CALCULATIONS			MINUTES/TRT	HRS/TRT					
PER TREATEMENT			**256.50**	**4.27**					
PRODUCT FLOW			ML/ MINUTE	LBS / MIN	LBS/10MIN	gal / hr			
Amount of product to deliver per unit of time									
DOMINUS			391.27	**0.8787**	**8.787**	**6.20**			
DOMINUS			521.69	**1.1716**	**11.716**	**8.27**			
PIC-CHLOR 60			386.52	**1.2060**	**12.060**	**6.13**			
IRF135 - 10 Gal Mix			326.77	**0.7338**	**7.338**	**5.18**		Gal/Hr	
			check	188.23	Lbs/trt	**0.9**		gal/Min	
PPM TARGET CONCENTRATION									
CONCENTRATION			PPM						
			TARGET						
DOMINUS	**0.002531**		2,531.34						
PIC-CHLOR 60	**0.001875**		1,875.46						

Re-entry Procedure

The Objective of the re-entry procedure is to insure that the label prescribed REP of 5 days or 120 hours is sufficient to allow the entry of workers into the treated area. Prior to clearing the treated area, a site inspector with appropriate PPE available must confirm that the presence of AITC is below the threshold of 2 ppm as measured with Gastec or Rae System type detector tubes and/or devices.

- The site inspector, upon arriving at the treated site, should inspect the tarp conditions and ensure no unauthorized personnel are within the treated area.
- Beginning with the upwind corner of the treated area, inspect for any sensory response to the presence of AITC followed by use of the Gastec detector and/or Rae System devices. Once the area has been tested and shown to be below threshold limits continue to take samples at regular intervals around the field, ending up at the most downwind portion of the field.
- If at any time there is detection above the threshold or sensory response is noted the site inspector should wait for 5 -15 minutes before taking another sample. If the level of detection does not decrease then entry into the treated area is to be delayed until levels are below detection and sensory response is no longer noted.

DOMINUS®

AIR AND SOIL MONITORING

APPENDIX A

Produ

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BETTER TECHNOLOGY. BETTER QUALITY. BETTER VALUE.

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- » Respiratory Protection
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dDwtMTMzOTEwNT

Gas Detection » Detector Tubes » Methyl methacrylate: Allyl isothiocyanate

Tube Name: Methyl methacrylate / Chemical: Allyl isothiocyanate

Tube Data	
Tube Number:	149
Gastec Tube Name:	Methyl methacrylate
Chemical:	Allyl isothiocyanate
Range:	5-200
Shelf Life (years):	2
Notes:	T

Gastec Detector Tubes offer advanced technology that adds up to more accurate and reliable analysis with lower standard deviation. With detection limits for many chemicals lower than competitor limits, Gastec tubes detect trace levels of contaminants that competitors cannot. Additionally, Gastec's higher maximum detection limits can provide a wider range of contaminant measurement.

Offering some of the broadest operating temperature ranges available, Gastec Detector Tubes can be used in virtually any environment—from 32°F to 104°F.

Each tube contains a reagent that is highly sensitive to the target substance and quickly produces a distinct color change when the chemical is present. While some competitor tubes display semi-quantitative results, Gastec Detector Tubes provide exact quantitative measurements. The pre-calibrated, direct-read detector tubes offer distinct lines of demarcation for easier viewing and require no interpretation, dual scales, or color charts.

To expedite analysis, many Gastec tubes require only 1 pump stroke. Alternatively, competitors can require up to 20 pump strokes to measure the same substance.

You can rely on Gastec quality. No other manufacturer has more detector tubes certified by the Safety Equipment Institute (SEI) than Gastec. To ensure the highest level of quality, Gastec products are manufactured in ISO-9001 certified facilities. Gastec Detector Tubes and Gas Sampling Pumps are designed, manufactured, and calibrated to work together to produce accurate readings.

Each box of standard Gastec Detector Tubes contains 10 tubes and can conduct 10 total tests. A comprehensive instruction sheet is included with each box.

The instruction sheets represented here are examples of the typical instructions for each part number. The actual instruction sheet found in each box of Gastec detector tubes may vary slightly for each lot number of detector tubes from the typical instruction sheet found here. **FOR PROPER PERFORMANCE, CONSULT THE ACTUAL INSTRUCTIONS IN EACH BOX OF DETECTOR TUBES.**

If you require an additional instruction sheet for your specific lot number of detector tubes, please contact Nextteq Customer Service toll free at 877-312-2333 x20 or info@nextteq.com.

Associated Files:	
Instructions	149.pdf
MSDS	149_03E_MSDS.pdf
Data Sheet	Methyl_Methacrylate_149.pdf

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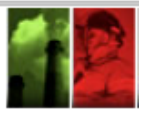
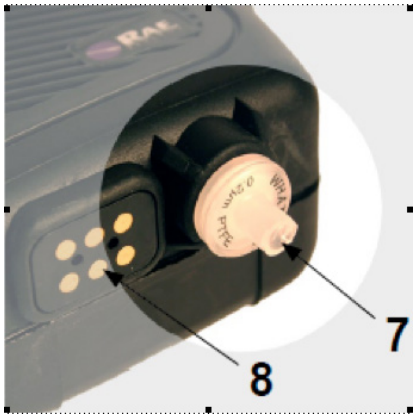


ENTRY RAE USER MANUAL

Entry RAE: User Notice

1) Physical Description:

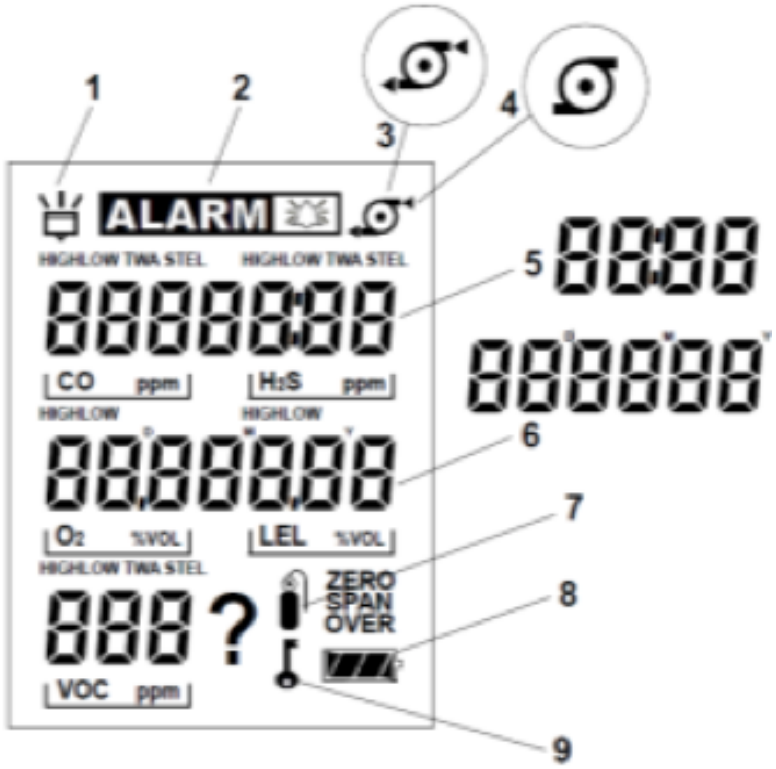
1. Display
2. Operation/programmer keys
3. Charge status
4. Visual alarm
5. Gas plate
6. Buzzer
7. Gas inlet with external filter
8. Charging contacts
9. Charging cradle
10. Power jack
11. RS-232 port



Bottom of monitor

2) Display and Legend:

1. PID lamp alarm
2. Alarm conditions
3. Pump on
4. Pump off
5. Time
6. Date (Day, Month, Year)
7. Apply calibration gas
8. Battery charge status
9. Password protected



3) Turning the Monitor ON/OFF:

To turn the monitor ON:

1. Press the Φ button for 1 second

To turn the monitor OFF:

1. Press the Φ button for 5 seconds
2. The display will count-down from 5 to 1 (5 seconds)
3. Release @when “Unit Off” appears on the display
4. Return the Entry RAE to the dry, indoor storage area and put it in its charger

Calibration for DOMINUS® Detection:

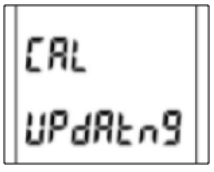
1) Turning the Monitor ON:

1. Press the Φ button for 1 second

2. Press and hold “Φ + N” for 3 seconds

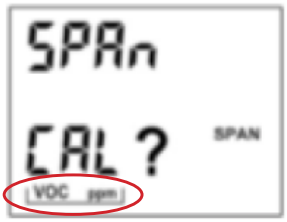
3. “Fresh Air” press “Y” to zero for all sensors

4. The sensor displays “Cal Updtng” and is updating data



5. Push on “N” until arriving at the display Span Cal VOC

6. Display “Span Cal VOC”



7. Connect standard gas (100ppm Isobutylene)

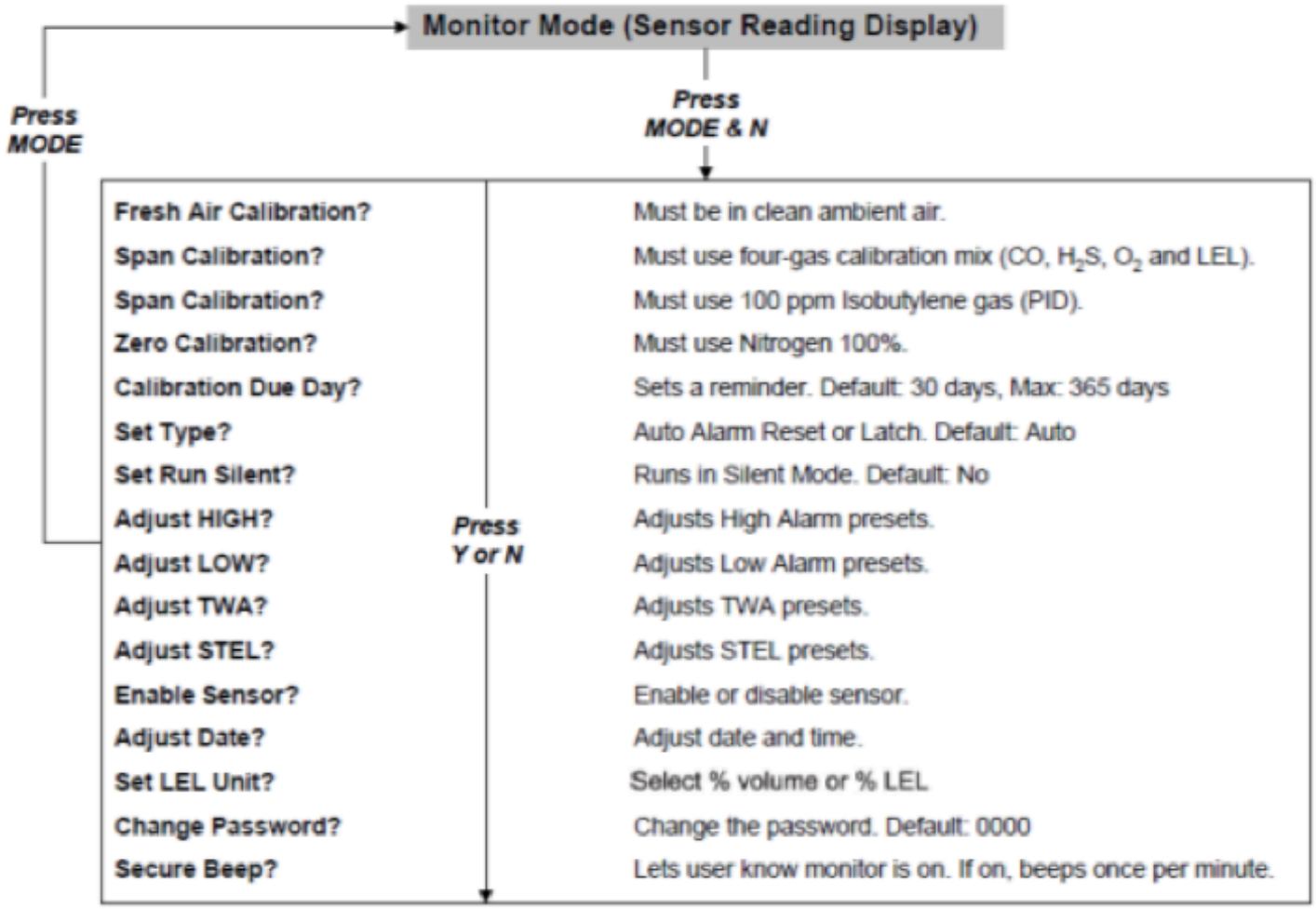
Gas connector

Entry RAE connected to the 100ppm Isobutylene for calibration

8. At the display “Apply Gas” open the valve of the Isobutylene calibration gas

9. Press “Y” wait for the countdown (30 seconds)

10. Press “Φ” to return to monitor mode


Monitor Mode (Sensor Reading Display)
Press MODE & N
Press MODE
Press Y or N
Fresh Air Calibration?
Must be in clean ambient air.
Span Calibration?
Must use four-gas calibration mix (CO, H2S, O2 and LEL).
Span Calibration?
Must use 100 ppm Isobutylene gas (PID).
Zero Calibration?
Must use Nitrogen 100%.
Calibration Due Day?
Sets a reminder. Default: 30 days, Max: 365 days
Set Type?
Auto Alarm Reset or Latch. Default: Auto
Set Run Silent?
Runs in Silent Mode. Default: No
Adjust HIGH?
Adjusts High Alarm presets.
Adjust LOW?
Adjusts Low Alarm presets.
Adjust TWA?
Adjusts TWA presets.
Adjust STEL?
Adjusts STEL presets.
Enable Sensor?
Enable or disable sensor.
Adjust Date?
Adjust date and time.
Set LEL Unit?
Select % volume or % LEL
Change Password?
Change the password. Default: 0000
Secure Beep?
Lets user know monitor is on. If on, beeps once per minute.

Entry RAE Use For DOMINUS® Application:

1) During the Application:

Wear the appropriate PPE as described in the stewardship training manual

To turn the monitor ON:

1. Press the Φ button for 1 second

Alarms

If the Entry RAE detects any level of gas, an **ALARM (visual and hearing)** is produced. When you heard this alarm, it means that a problem has occurred:

Leaks or spillage in:

- Irrigation system,
- DOMINUS® Kegs

What to do in case of alarm?

1. Ensure that all PPE is correctly worn,
2. Stop the application,
3. Fix the leaks or spillage

2) Once the application is completed:

To turn the monitor OFF:

1. Press the Φ button for 5 seconds
2. The display will count-down from 5 to 1 (5 seconds)
3. Release the Φ button when “Unit Off” appears on the display
4. Return the Entry RAE to the dry, indoor storage area and put it in its charger

3) Data recovery:

Data logging occurs automatically for all enabled sensors at one minute intervals, allowing five days of continuous data storage. When the end of the storage memory is reached, the monitor will automatically wrap around to the beginning of the log and overwrite the oldest stored data.

4) Charging the Entry RAE:

The Li-Ion battery pack can be charged alone or while it is installed in the monitor. To charge an installed battery simply plug the transformer into the cradle and into an outlet. Place the monitor in the cradle.

The monitor is still charging when:

- The LED on the charging cradle is red
- The “Monitor Charging” message appears on the display
- The battery segments are scrolling

The monitor is fully charged when:

- The “Fully Charged” message appears on the display
- The LED on the charging cradle is green
- The set of battery segments are blinking

Calibration of Entry PGM RAE - Setting Up of the Limit of Detection Min/Max

1. Push on the switch « Mode » and « N »
2. Fresh air calibration ➜ N
3. Span Calibration ➜ N
4. Span calibration ➜ N
5. Zero calibration ➜ N
6. Calib due day ➜ N
7. Set type ➜ N
8. Set run silence ➜ N
9. Set run silence ➜ N
10. Adjust High ➜ Y
    a. Then push on switch N until arriving to « VOCppm »

b. Once on « VOC ppm » push on Mode
c. As a maximum value of detection put 999 ppm
- Push on « Y » until you get the number 9,
- Push on « mode », then you can enter the second number. Push on « Y » until reaching the number 9,
- Push on « mode », then you can enter the third number. Push on « Y » until reaching the number 9,
- You get now 999ppm as high value of detection « High »,
- Push on « mode »
- The following signage « ? » comes
- Push on Y and mode on same time to validate the value 999ppm

11. Adjust Low
    a. Make the same procedure as describe before
    b. Set the Low value to the AITC detection limit of 2ppm by entering 002 ppm

Correction Factors, Ionization Energies*, And Calibration Characteristics

Correction Factors and Ionization Energies

RAE Systems PIDs can be used for the detection of a wide variety of gases that exhibit different responses. In general, any compound with ionization energy (IE) lower than that of the lamp photons can be measured.* The best way to calibrate a PID to different compounds is to use a standard of the gas of interest. However, correction factors have been determined that enable the user to quantify a large number of chemicals using only a single calibration gas, typically isobutylene. In our PIDs, correction factors can be used in one of three ways:

1) Calibrate the monitor with isobutylene in the usual fashion to read in isobutylene equivalents. Manually multiply the reading by the correction factor (CF) to obtain the concentration of the gas being measured.

2) Calibrate the unit with isobutylene in the usual fashion to read in isobutylene equivalents. Call up the correction factor from the instrument memory or download it from a personal computer and then call it up. The monitor will then read directly in units of the gas of interest.

3) Calibrate the unit with isobutylene, but input an equivalent, "corrected" span gas concentration when prompted for this value. The unit will then read directly in units of the gas of interest.

* *The term "ionization energy" is more scientifically correct and replaces the old term "ionization potential." High-boiling ("heavy") compounds may not vaporize enough to give a response even when their ionization energies are below the lamp photon energy. Some inorganic compounds like H_2O_2 and NO_2 give weak response even when their ionization energies are well below the lamp photon energy.*

Example 1:
With the unit calibrated to read isobutylene equivalents, the reading is 10 ppm with a 10.6 eV lamp. The gas being measured is butyl acetate, which has a correction factor of 2.6. Multiplying 10 by 2.6 gives an adjusted butyl acetate value of 26 ppm. Similarly, if the gas being measured were trichloroethylene (CF = 0.54), the adjusted value with a 10 ppm reading would be 5.4 ppm.

Example 2:
With the unit calibrated to read isobutylene equivalents, the reading is 100 ppm with a 10.6 eV lamp. The gas measured is m-xylene (CF = 0.43). After downloading this factor, the unit should read about 43 ppm when exposed to the same gas, and thus read directly in m-xylene values.

Example 3:
The desired gas to measure is ethylene dichloride (EDC). The CF is 0.6 with an 11.7 eV lamp. During calibration with 100 ppm isobutylene, insert 0.6 times 100, or 60 at the prompt for the calibration gas concentration. The unit then reads directly in EDC values.

Conversion to mg/m^3

To convert from ppm to mg/m^3, use the following formula:

$$\text{Conc.}\ (mg/m^3) = \frac{[\text{Conc.(ppmv)} \times \text{mol. wt. (g/mole)}]}{\text{molar gas volume (L)}}$$

For air at 25 °C (77 °F), the molar gas volume is 24.4 L/mole and the formula reduces to:

$$\text{Conc.}(mg/m^3) = \text{Conc.(ppmv)} \times \text{mol. wt. (g/mole)} \times 0.041$$

For example, if the instrument is calibrated with a gas standard in ppmv, such as 100 ppm isobutylene, and the user wants the display to read in mg/m^3 of hexane, whose m.w. is 86 and CF is 4.3, the overall correction factor would be 4.3 x 86 x 0.041 equals 15.2.

Correction Factors for Mixtures

The correction factor for a mixture is calculated from the sum of the mole fractions Xi of each component divided by their respective correction factors CFi:

$$CFmix = 1 / (X_1/CF_1 + X_2/CF_2 + X_3/CF_3 + \ldots Xi/CFi)$$

Thus, for example, a vapor phase mixture of 5% benzene and 95% n-hexane would have a CFmix of CFmix = 1 / (0.05/0.53 + 0.95/4.3) = 3.2. A reading of 100 would then correspond to 320 ppm of the total mixture, comprised of 16 ppm benzene and 304 ppm hexane.

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For a spreadsheet to compute the correction factor and TLV of a mixture see the appendix at the end of the CF table.

TLVs and Alarm Limits for Mixtures

The correction factor for mixtures can be used to set alarm limits for mixtures. To do this one first needs to calculate the exposure limit for the mixture. The Threshold Limit Value (TLV) often defines exposure limits. The TLV for the mixture is calculated in a manner similar to the CF calculation:

$$TLV\ mix = 1 / (X_1/TLV_1 + X_2/TLV_2 + X_3/TLV_3 + ... Xi/TLVi)$$

In the above example, the 8-h TLV for benzene is 0.5 ppm and for n-hexane 50 ppm. Therefore the TLV of the mixture is TLVmix = 1 / (0.05/0.5 + 0.95/50) = 8.4 ppm, corresponding to 8.0 ppm hexane and 0.4 ppm benzene. For an instrument calibrated on isobutylene, the reading corrsponding to the TLV is:

$$Alarm\ Reading = TLVmix / CFmix = 8.4 / 3.2 = 2.6\ ppm$$

A common practice is to set the lower alarm limit to half the TLV, and the higher limit to the TLV. Thus, one would set the alarms to 1.3 and 2.6 ppm, respectively.

Calibration Characteristics

a) Flow Configuration. PID response is essentially independent of gas flow rate as long as it is sufficient to satisfy the pump demand. Four main flow configurations are used for calibrating a PID:

1) **Pressurized gas cylinder (Fixed-flow regulator):** The flow rate of the regulator should match the flow demand of the instrument pump or be slightly higher.
2) **Pressurized gas cylinder (Demand-flow regulator):** A demand-flow regulator better matches pump speed differences, but results in a slight vacuum during calibration and thus slightly high readings.
3) **Collapsible gas bag:** The instrument will draw the calibration gas from the bag at its normal flow rate, as long as the bag valve is large enough. The bag should be filled with enough gas to allow at least one minute of flow (~ 0.6 L for a MiniRAE, ~0.3 L for MultiRAE).
4) **T (or open tube) method:** The T method uses a T-junction with gas flow higher than the pump draw. The gas supply is connected to one end of the T, the instrument inlet is connected to a second end of the T, and excess gas flow escapes through the third, open end of the T. To prevent ambient air mixing, a long tube should be connected to the open end, or a high excess rate should be used. Alternatively, the instrument probe can be inserted into an open tube slightly wider than the probe. Excess gas flows out around the probe.

The first two cylinder methods are the most efficient in terms of gas usage, while the bag and T methods give slightly more accurate results because they match the pump flow better.

b) Pressure. Pressures deviating from atmospheric pressure affect the readings by altering gas concentration and pump characteristics. It is best to calibrate with the instrument and calibration gas at the same pressure as each other and the sample gas. (Note that the cylinder pressure is not relevant because the regulator reduces the pressure to ambient.) If the instrument is calibrated at atmospheric pressure in one of the flow configurations described above, then 1) pressures slightly above ambient are acceptable but high pressures can damage the pump and 2) samples under vacuum may give low readings if air leaks into the sample train.

c) Temperature. Because temperature effects gas density and concentration, the temperature of the calibration gas and instrument should be as close as possible to the ambient temperature where the unit will be used. We recommend that the temperature of the calibration gas be within the instrument's temperature specification (typically 14° to 113° F or -10° to 45° C). Also, during actual measurements, the instrument should be kept at the same or higher temperature than the sample temperature to avoid condensation in the unit.

d) Matrix. The matrix gas of the calibration compound and VOC sample is significant. Some common matrix components, such as methane and water vapor can affect the VOC signal. PIDs are

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most commonly used for monitoring VOCs in air, in which case the preferred calibration gas matrix is air. For a MiniRAE, methane, methanol, and water vapor reduce the response by about 20% when their concentration is 15,000 ppm and by about 40% at 30,000 ppm. Despite earlier reports of oxygen effects, RAE PID responses with 10.6 eV lamps are independent of oxygen concentration, and calibration gases in a pure nitrogen matrix can be used. H_2 and CO_2 up to 5 volume % also have no effect.

e) Concentration. Although RAE Systems PIDs have electronically linearized output, it is best to calibrate in a concentration range close to the actual measurement range. For example, 100 ppm standard gas for anticipated vapors of 0 to 250 ppm, and 500 ppm standard for expected concentrations of 250 to 1000 ppm. The correction factors in this table were typically measured at 50 to 100 ppm and apply from the ppb range up to about 1000 ppm. Above 1000 ppm the CF may vary and it is best to calibrate with the gas of interest near the concentration of interest.

f) Filters. Filters affect flow and pressure conditions and therefore all filters to be used during sampling should also be in place during calibration. Using a water trap (hydrophobic filter) greatly reduces the chances of drawing water aerosols or dirt particles into the instrument. Regular filter replacements are recommended because dirty filters can adsorb VOCs and cause slower response time and shifts in calibration.

g) Instrument Design. High-boiling ("heavy") or very reactive compounds can be lost by reaction or adsorption onto materials in the gas sample train, such as filters, pumps and other sensors. Multi-gas meters, including EntryRAE, MultiRAE and AreaRAE have the pump and other sensors upstream of the PID and are prone to these losses. Compounds possibly affected by such losses are shown in green in the table, and may give slow response, or in extreme cases, no response at all. In many cases the multi-gas meters can still give a rough indication of the relative concentration, without giving an accurate, quantitative reading. The ppbRAE and MiniRAE series instruments have inert sample trains and therefore do not exhibit significant loss; nevertheless, response may be slow for the very heavy compounds and additional sampling time up to a minute or more should be allowed to get a stable reading.

Table Abbreviations:

CF = Correction Factor (multiply by reading to get corrected value for the compound when calibrated to isobutylene)
NR = No Response
IE = Ionization Energy (values in parentheses are not well established)
C = Confirmed Value indicated by "+" in this column; all others are preliminary or estimated values and are subject to change
ne = Not Established ACGIH 8-hr. TWA
C## = Ceiling value, given where 8-hr.TWA is not available

Disclaimer:

Actual readings may vary with age and cleanliness of lamp, relative humidity, and other factors. For accurate work, the instrument should be calibrated regularly under the operating conditions used. The factors in this table were measured in dry air at room temperature, typically at 50-100 ppm. CF values may vary above about 1000 ppm.

Updates:

The values in this table are subject to change as more or better data become available. Watch for updates of this table on the Internet at **http://www.raesystems.com**

IE data are taken from the CRC Handbook of Chemistry and Physics, 73rd Edition, D.R. Lide (Ed.), CRC Press (1993) and NIST Standard Ref. Database 19A, NIST Positive Ion Energetics, Vers. 2.0, Lias, et.al., U.S. Dept. Commerce (1993). Exposure limits (8-h TWA and Ceiling Values) are from the 2005 ACGIH Guide to Occupational Exposure Values, ACGIH, Cincinnati, OH 2005. Equations for exposure limits for mixtures of chemicals were taken from the 1997 TLVs and BEIs handbook published by the ACGIH (1997).

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Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Acetaldehyde		75-07-0	C_2H_4O	NR	+	6	+	3.3	+	10.23	C25
Acetic acid	Ethanoic Acid	64-19-7	$C_2H_4O_2$	NR	+	22	+	2.6	+	10.66	10
Acetic anhydride	Ethanoic Acid Anhydride	108-24-7	$C_4H_6O_3$	NR	+	6.1	+	2.0	+	10.14	5
Acetone	2-Propanone	67-64-1	C_3H_6O	1.2	+	1.1	+	1.4	+	9.71	500
Acetone cyanohydrin	2-Hydroxyisobutyronitrile	75-86-5	C_4H_7NO					4	+	11.1	C5
Acetonitrile	Methyl cyanide, Cyanomethane	75-05-8	C_2H_3N					100		12.19	40
Acetylene	Ethyne	74-86-2	C_2H_2					2.1	+	11.40	ne
Acrolein	Propenal	107-02-8	C_3H_4O	42	+	3.9	+	1.4	+	10.10	0.1
Acrylic acid	Propenoic Acid	79-10-7	$C_3H_4O_2$			12	+	2.0	+	10.60	2
Acrylonitrile	Propenenitrile	107-13-1	C_3H_3N			NR	+	1.2	+	10.91	2
Allyl alcohol		107-18-6	C_3H_6O	4.5	+	2.4	+	1.6	+	9.67	2
Allyl chloride	3-Chloropropene	107-05-1	C_3H_5Cl			4.3		0.7		9.9	1
Ammonia		7664-41-7	H_3N	NR	+	9.7	+	5.7	+	10.16	25
Amyl acetate	mix of n-Pentyl acetate & 2-Methylbutyl acetate	628-63-7	$C_7H_{14}O_2$	11	+	2.3	+	0.95	+	<9.9	100
Amyl alcohol	1-Pentanol	75-85-4	$C_5H_{12}O$			5		1.6		10.00	ne
Aniline	Aminobenzene	62-53-3	C_7H_7N	0.50	+	0.48	+	0.47	+	7.72	2
Anisole	Methoxybenzene	100-66-3	C_7H_8O	0.89	+	0.58	+	0.56	+	8.21	ne
Arsine	Arsenic trihydride	7784-42-1	AsH_3			1.9	+			9.89	0.05
Benzaldehyde		100-52-7	C_7H_6O					1		9.49	ne
Benzenamine, N-methyl-	N-Methylphenylamine	100-61-8	C_7H_9N			0.7				7.53	
Benzene		71-43-2	C_6H_6	0.55	+	0.53	+	0.6	+	9.25	0.5
Benzonitrile	Cyanobenzene	100-47-0	C_7H_5N			1.6				9.62	ne
Benzyl alcohol	α-Hydroxytoluene, Hydroxymethylbenzene, Benzenemethanol	100-51-6	C_7H_8O	1.4	+	1.1	+	0.9	+	8.26	ne
Benzyl chloride	α-Chlorotoluene, Chloromethylbenzene	100-44-7	C_7H_7Cl	0.7	+	0.6	+	0.5	+	9.14	1
Benzyl formate	Formic acid benzyl ester	104-57-4	$C_8H_8O_2$	0.9	+	0.73	+	0.66	+		ne
Boron trifluoride		7637-07-2	BF_3	NR		NR		NR		15.5	C1
Bromine		7726-95-6	Br_2	NR	+	1.30	+	0.74	+	10.51	0.1
Bromobenzene		108-86-1	C_6H_5Br			0.6		0.5		8.98	ne
2-Bromoethyl methyl ether		6482-24-2	C_3H_7OBr			0.84	+			~10	ne
Bromoform	Tribromomethane	75-25-2	$CHBr_3$	NR	+	2.5	+	0.5	+	10.48	0.5
Bromopropane,1-	n-Propyl bromide	106-94-5	C_3H_7Br	150	+	1.5	+	0.6	+	10.18	ne
Butadiene	1,3-Butadiene, Vinyl ethylene	106-99-0	C_4H_6	0.8		0.85	+	1.1		9.07	2
Butadiene diepoxide, 1,3-	1,2,3,4-Diepoxybutane	298-18-0	$C_4H_6O_2$	25	+	3.5	+	1.2		~10	ne
Butanal	1-Butanal	123-72-8	C_4H_8O			1.8				9.84	
Butane		106-97-8	C_4H_{10}			67	+	1.2		10.53	800
Butanol, 1-	Butyl alcohol, n-Butanol	71-36-3	$C_4H_{10}O$	70	+	4.7	+	1.4	+	9.99	20
Butanol, t-	tert-Butanol, t-Butyl alcohol	75-65-0	$C_4H_{10}O$	6.9	+	2.9	+			9.90	100
Butene, 1-	1-Butylene	106-98-9	C_4H_8			0.9				9.58	ne
Butoxyethanol, 2-	Butyl Cellosolve, Ethylene glycol monobutyl ether	111-76-2	$C_6H_{14}O_2$	1.8	+	1.2	+	0.6	+	<10	25
Butoxyethanol acetate	Ethanol, 2-(2-butoxyethoxy)-, acetate	124-17-4	$C_{10}H_{20}O_4$			5.6				≤10.6	
Butoxyethoxyethanol	2-(2-Butoxyethoxy)ethanol	112-34-5	$C_8H_{18}O_3$			4.6				≤10.6	
Butyl acetate, n-		123-86-4	$C_6H_{12}O_2$			2.6	+			10	150
Butyl acrylate, n-	Butyl 2-propenoate, Acrylic acid butyl ester	141-32-2	$C_7H_{12}O_2$			1.6	+	0.6	+		10
Butylamine, n-		109-73-9	$C_4H_{11}N$	1.1	+	1.1	+	0.7	+	8.71	C5
Butyl cellosolve	see 2-Butoxyethanol	111-76-2									
Butyl hydroperoxide, t-		75-91-2	$C_4H_{10}O_2$	2.0	+	1.6	+			<10	1
Butyl mercaptan	1-Butanethiol	109-79-5	$C_4H_{10}S$	0.55	+	0.52	+			9.14	0.5
Carbon disulfide		75-15-0	CS_2	4	+	1.2	+	0.44		10.07	10
Carbon tetrachloride	Tetrachloromethane	56-23-5	CCl_4	NR	+	NR	+	1.7	+	11.47	5
Carbonyl sulfide	Carbon oxysulfide	463-58-1	COS							11.18	

Cellosolve see 2-Ethoxyethanol
CFC-14 see Tetrafluoromethane
CFC-113 see 1,1,2-Trichloro-1,2,2-trifluoroethane

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Chlorine		7782-50-5	Cl_2					1.0	+	11.48	0.5
Chlorine dioxide		10049-04-4	ClO_2	NR	+	NR	+	NR	+	10.57	0.1
Chlorobenzene	Monochlorobenzene	108-90-7	C_6H_5Cl	0.44	+	0.40	+	0.39	+	9.06	10
Chlorobenzotrifluoride, 4-	PCBTF, OXSOL 100 p-Chlorobenzotrifluoride	98-56-6	$C_7H_4ClF_3$	0.74	+	0.63	+	0.55	+	<9.6	25
Chloro-1,3-butadiene, 2-	Chloroprene	126-99-8	C_4H_5Cl			3					10
Chloro-1,1-difluoroethane, 1-	HCFC-142B, R-142B	75-68-3	$C_2H_3ClF_2$	NR		NR		NR		12.0	ne
Chlorodifluoromethane	HCFC-22, R-22	75-45-6	$CHClF_2$	NR		NR		NR		12.2	1000
Chloroethane	Ethyl chloride	75-00-3	C_2H_5Cl	NR	+	NR	+	1.1	+	10.97	100
Chloroethanol	Ethylene chlrohydrin	107-07-3	C_2H_5ClO					2.9		10.52	C1
Chloroethyl ether, 2-	bis(2-chloroethyl) ether	111-44-4	$C_4H_8Cl_2O$	8.6	+	3.0	+				5
Chloroethyl methyl ether, 2-	Methyl 2-chloroethyl ether	627-42-9	C_3H_7ClO			3					ne
Chloroform	Trichloromethane	67-66-3	$CHCl_3$	NR	+	NR	+	3.5	+	11.37	10
Chloro-2-methylpropene, 3-	Methallyl chloride, Isobutenyl chloride	563-47-3	C_4H_7Cl	1.4	+	1.2	+	0.63	+	9.76	ne
Chloropicrin		76-06-2	CCl_3NO_2	NR	+	~400	+	7	+	?	0.1
Chlorotoluene, o-	o-Chloromethylbenzene	95-49-8	C_7H_7Cl			0.5		0.6		8.83	50
Chlorotoluene, p-	p-Chloromethylbenzene	106-43-4	C_7H_7Cl					0.6		8.69	ne
Chlorotrifluoroethene	CTFE, Chlorotrifluoroethylene Genetron 1113	79-38-9	C_2ClF_3	6.7	+	3.9	+	1.2	+	9.76	5
Chlorotrimethylsilane		75-77-4	C_3H_9ClSi	NR		NR		0.82	+	10.83	ne
Cresol, m-	m-Hydroxytoluene	108-39-4	C_7H_8O	0.57	+	0.50	+	0.57	+	8.29	5
Cresol, o-	o-Hydroxytoluene	95-48-7	C_7H_8O			1.0				8.50	
Cresol, p-	p-Hydroxytoluene	106-44-5	C_7H_8O			1.4				8.35	
Crotonaldehyde	*trans*-2-Butenal	123-73-9 4170-30-3	C_4H_6O	1.5	+	1.1	+	1.0	+	9.73	2
Cumene	Isopropylbenzene	98-82-8	C_9H_{12}	0.58	+	0.54	+	0.4	+	8.73	50
Cyanogen bromide		506-68-3	CNBr	NR		NR		NR		11.84	ne
Cyanogen chloride		506-77-4	CNCl	NR		NR		NR		12.34	C0.3
Cyclohexane		110-82-7	C_6H_{12}	3.3	+	1.4	+	0.64	+	9.86	300
Cyclohexanol	Cyclohexyl alcohol	108-93-0	$C_6H_{12}O$	1.5	+	0.9	+	1.1	+	9.75	50
Cyclohexanone		108-94-1	$C_6H_{10}O$	1.0	+	0.9	+	0.7	+	9.14	25
Cyclohexene		110-83-8	C_6H_{10}			0.8	+			8.95	300
Cyclohexylamine		108-91-8	$C_6H_{13}N$			1.2				8.62	10
Cyclopentane 85% 2,2-dimethylbutane 15%		287-92-3	C_5H_{10}	NR	+	15	+	1.1		10.33	600
Cyclopropylamine	Aminocyclpropane	765-30-0	C_3H_7N	1.1	+	0.9	+	0.9	+		ne
Decamethylcyclopentasiloxane		541-02-6	$C_{10}H_{30}O_5Si_5$	0.16	+	0.13	+	0.12	+		ne
Decamethyltetrasiloxane		141-62-8	$C_{10}H_{30}O_3Si_4$	0.17	+	0.13	+	0.12	+	<10.2	ne
Decane		124-18-5	$C_{10}H_{22}$	4.0	+	1.4	+	0.35	+	9.65	ne
Diacetone alcohol	4-Methyl-4-hydroxy-2-pentanone	123-42-2	$C_6H_{12}O_2$			0.7					50
Dibromochloromethane	Chlorodibromomethane	124-48-1	$CHBr_2Cl$	NR	+	5.3	+	0.7	+	10.59	ne
Dibromo-3-chloropropane, 1,2-	DBCP	96-12-8	$C_3H_5Br_2Cl$	NR	+	1.7	+	0.43	+		0.001
Dibromoethane, 1,2-	EDB, Ethylene dibromide, Ethylene bromide	106-93-4	$C_2H_4Br_2$	NR	+	1.7	+	0.6	+	10.37	ne
Dichlorobenzene, o-	1,2-Dichlorobenzene	95-50-1	$C_6H_4Cl_2$	0.54	+	0.47	+	0.38	+	9.08	25
Dichlorodifluoromethane	CFC-12	75-71-8	CCl_2F_2			NR	+	NR	+	11.75	1000
Dichlorodimethylsilane		75-78-5	$C_2H_6Cl_2Si$	NR		NR		1.1	+	>10.7	ne
Dichloroethane, 1,2-	EDC, 1,2-DCA, Ethylene dichloride	107-06-2	$C_2H_4Cl_2$			NR	+	0.6	+	11.04	10
Dichloroethene, 1,1-	1,1-DCE, Vinylidene chloride	75-35-4	$C_2H_2Cl_2$			0.82	+	0.8	+	9.79	5
Dichloroethene, c-1,2-	*c*-1,2-DCE, *cis*-Dichloroethylene	156-59-2	$C_2H_2Cl_2$			0.8				9.66	200
Dichloroethene, t-1,2-	*t*-1,2-DCE, *trans*-Dichloroethylene	156-60-5	$C_2H_2Cl_2$			0.45	+	0.34	+	9.65	200
Dichloro-1-fluoroethane, 1,1-	R-141B	1717-00-6	$C_2H_3Cl_2F$	NR	+	NR	+	2.0	+		ne
Dichloromethane	see Methylene chloride										

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Dichloropentafluoropropane	AK-225, mix of ~45% 3,3-dichloro-1,1,1,2,2-pentafluoro-propane (HCFC-225ca) & ~55% 1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)	442-56-0 507-55-1	$C_3HCl_2F_5$	NR	+	NR	+	25	+		ne
Dichloropropane, 1,2-		78-87-5	$C_3H_6Cl_2$					0.7		10.87	75
Dichloro-1-propene, 1,3-		542-75-6	$C_3H_4C_{12}$	1.3	+	0.96	+			<10	1
Dichloro-1-propene, 2,3-		78-88-6	$C_3H_4Cl_2$	1.9	+	1.3	+	0.7	+	<10	ne
Dichloro-1,1,1-trifluoroethane, 2,2-	R-123	306-83-2	$C_2HCl_2F_3$	NR	+	NR	+	10.1	+	11.5	ne
Dichloro-2,4,6-trifluoropyridine, 3,5-	DCTFP	1737-93-5	$C_5Cl_2F_3N$	1.1	+	0.9	+	0.8	+		ne
Dichlorvos *	Vapona; O,O-dimethyl O-dichlorovinyl phosphate	62-73-7	$C_4H_7Cl_2O_4P$			0.9	+			<9.4	0.1
Dicyclopentadiene	DCPD, Cyclopentadiene dimer	77-73-6	$C_{10}H_{12}$	0.57	+	0.48	+	0.43	+	8.8	5
Diesel Fuel		68334-30-5	m.w. 226			0.9	+				11
Diesel Fuel #2 (Automotive)		68334-30-5	m.w. 216	1.3		0.7	+	0.4	+		11
Diethylamine		109-89-7	$C_4H_{11}N$			1	+			8.01	5
Diethylaminopropylamine, 3-		104-78-9	$C_7H_{18}N_2$			1.3					ne
Diethylbenzene	See Dowtherm J										
Diethylmaleate		141-05-9	$C_8H_{12}O_4$			4					ne
Diethyl sulfide	see Ethyl sulfide										
Diglyme	See Methoxyethyl ether	111-96-6	$C_6H_{14}O_3$								
Diisobutyl ketone	DIBK, 2,2-dimethyl-4-heptanone	108-83-8	$C_9H_{18}O$	0.71	+	0.61	+	0.35	+	9.04	25
Diisopropylamine		108-18-9	$C_6H_{15}N$	0.84	+	0.74	+	0.5	+	7.73	5
Diketene	Ketene dimer	674-82-8	$C_4H_4O_2$	2.6	+	2.0	+	1.4	+	9.6	0.5
Dimethylacetamide, N,N-	DMA	127-19-5	C_4H_9NO	0.87	+	0.8	+	0.8	+	8.81	10
Dimethylamine		124-40-3	C_2H_7N			1.5				8.23	5
Dimethyl carbonate	Carbonic acid dimethyl ester	616-38-6	$C_3H_6O_3$	NR	+	~70	+	1.7	+	~10.5	ne
Dimethyl disulfide	DMDS	624-92-0	$C_2H_6S_2$	0.2	+	0.20	+	0.21	+	7.4	ne
Dimethyl ether	see Methyl ether										
Dimethylethylamine	DMEA	598-56-1	$C_4H_{11}N$	1.1	+	1.0	+	0.9	+	7.74	~3
Dimethylformamide, N,N-	DMF	68-12-2	C_3H_7NO	0.7	+	0.7	+	0.8	+	9.13	10
Dimethylhydrazine, 1,1-	UDMH	57-14-7	$C_2H_8N_2$			0.8	+	0.8	+	7.28	0.01
Dimethyl methylphosphonate	DMMP, methyl phosphonic acid dimethyl ester	756-79-6	$C_3H_9O_3P$	NR	+	4.3	+	0.74	+	10.0	ne
Dimethyl sulfate		77-78-1	$C_2H_6O_4S$	~23		~20	+	2.3	+		0.1
Dimethyl sulfide	see Methyl sulfide										
Dimethyl sulfoxide	DMSO, Methyl sulfoxide	67-68-5	C_2H_6OS			1.4	+			9.10	ne
Dioxane, 1,4-		123-91-1	$C_4H_8O_2$			1.3				9.19	25
Dioxolane, 1,3-	Ethylene glycol formal	646-06-0	$C_3H_6O_2$	4.0	+	2.3	+	1.6	+	9.9	20
Dowtherm A see Therminol® *											
Dowtherm J (97% Diethylbenzene) *		25340-17-4	$C_{10}H_{14}$			0.5					
DS-108F Wipe Solvent	Ethyl lactate/Isopar H/ Propoxypropanol ~7:2:1	97-64-3 64742-48-9 1569-01-3	m.w. 118	3.3	+	1.6	+	0.7	+		ne
Epichlorohydrin	ECH Chloromethyloxirane, 1-chloro2,3-epoxypropane	106-89-8	C_2H_5ClO	~200	+	8.5	+	1.4	+	10.2	0.5
Ethane		74-84-0	C_2H_6			NR	+	15	+	11.52	ne
Ethanol	Ethyl alcohol	64-17-5	C_2H_6O			10	+	3.1	+	10.47	1000
Ethanolamine *	MEA, Monoethanolamine	141-43-5	C_2H_7NO	5.6	+	1.6	+			8.96	3
Ethene	Ethylene	74-85-1	C_2H_4			9	+	4.5	+	10.51	ne
Ethoxyethanol, 2-	Ethyl cellosolve	110-80-5	$C_4H_{10}O_2$			1.3				9.6	5
Ethyl acetate		141-78-6	$C_4H_8O_2$			4.6	+	3.5		10.01	400
Ethyl acetoacetate		141-97-9	$C_6H_{10}O_3$	1.4	+	1.2	+	1.0	+	<10	ne
Ethyl acrylate		140-88-5	$C_5H_8O_2$			2.4	+	1.0	+	<10.3	5
Ethylamine		75-04-7	C_2H_7N			0.8				8.86	5

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Ethylbenzene		100-41-4	C_8H_{10}	0.52	+	0.52	+	0.51	+	8.77	100
Ethyl caprylate	Ethyl octanoate	106-32-1	$C_{10}H_{20}O_2$		+	0.52	+	0.51	+		
Ethylenediamine	1,2-Ethanediamine; 1,2-Diaminoethane	107-15-3	$C_2H_8N_2$	0.9	+	0.8	+	1.0	+	8.6	10
Ethylene glycol *	1,2-Ethanediol	107-21-1	$C_2H_6O_2$			16	+	6	+	10.16	C100
Ethylene glycol, Acrylate	2-hydroxyethyl Acrylate	818-61-1	$C_5H_8O_3$			8.2				≤10.6	
Ethylene glycol dimethyl ether	1,2-Dimethoxyethane, Monoglyme	110-71-4	$C_4H_{10}O_2$	1.1		0.86		0.7		9.2	ne
Ethylene glycol monobutyl ether acetate	2-Butoxyethyl acetate	112-07-2	$C_8H_{16}O_3$			1.3				≤10.6	
Ethylene glycol, monothio	mercapto-2-ethanol	60-24-2	C_2H_6OS			1.5				9.65	
Ethylene oxide	Oxirane, Epoxyethane	75-21-8	C_2H_4O			13	+	3.5	+	10.57	1
Ethyl ether	Diethyl ether	60-29-7	$C_4H_{10}O$			1.1	+	1.7		9.51	400
Ethyl 3-ethoxypropionate	EEP	763-69-9	$C_7H_{14}O_3$	1.2	+	0.75	+				ne
Ethyl formate		109-94-4	$C_3H_6O_2$					1.9		10.61	100
Ethylhexyl acrylate, 2-	Acrylic acid 2-ethylhexyl ester	103-11-7	$C_{11}H_{20}O_2$			1.1	+	0.5	+		ne
Ethylhexanol	2-Ethyl-1-hexanol	104-76-7	C8$H_{18}O$			1.9				≤10.6	
Ethylidenenorbornene	5-Ethylidene bicyclo(2,2,1)hept-2-ene	16219-75-3	C_9H_{12}	0.4	+	0.39	+	0.34	+	≤8.8	ne
Ethyl (S)-(-)-lactate see also DS-108F	Ethyl lactate, Ethyl (S)-(-)-hydroxypropionate	687-47-8 97-64-3	$C_5H_{10}O_3$	13	+	3.2	+	1.6	+	~10	ne
Ethyl mercaptan	Ethanethiol	75-08-1	C_2H_6S	0.60	+	0.56	+			9.29	0.5
Ethyl sulfide	Diethyl sulfide	352-93-2	$C_4H_{10}S$			0.5	+			8.43	ne
Formaldehyde	Formalin	50-00-0	CH_2O	NR	+	NR	+	1.6	+	10.87	C0.3
Formamide		75-12-7	CH_3NO			6.9	+	4		10.16	10
Formic acid		64-18-6	CH_2O_2	NR	+	NR	+	9	+	11.33	5
Furfural	2-Furaldehyde	98-01-1	$C_5H_4O_2$			0.92	+	0.8	+	9.21	2
Furfuryl alcohol		98-00-0	$C_5H_6O_2$			0.80	+			<9.5	10
Gasoline #1		8006-61-9	m.w. 72			0.9	+				300
Gasoline #2, 92 octane		8006-61-9	m.w. 93	1.3	+	1.0	+	0.5	+		300
Glutaraldehyde	1,5-Pentanedial, Glutaric dialdehyde	111-30-8	$C_5H_8O_2$	1.1	+	0.8	+	0.6	+		C0.05
Glycidyl methacrylate	2,3-Epoxypropyl methacrylate	106-91-2	$C_7H_{10}O_3$	2.6	+	1.2	+	0.9	+		0.5
Halothane	2-Bromo-2-chloro-1,1,1-trifluoroethane	151-67-7	$C_2HBrClF_3$					0.6		11.0	50
HCFC-22 see Chlorodifluoromethane											
HCFC-123 see 2,2-Dichloro-1,1,1-trifluoroethane											
HCFC-141B see 1,1-Dichloro-1-fluoroethane											
HCFC-142B see 1-Chloro-1,1-difluoroethane											
HCFC-134A see 1,1,1,2-Tetrafluoroethane											
HCFC-225 see Dichloropentafluoropropane											
Heptane, n-		142-82-5	C_7H_{16}	45	+	2.8	+	0.60	+	9.92	400
Heptanol, 4-	Dipropylcarbinol	589-55-9	$C_7H_{16}O$	1.8	+	1.3	+	0.5	+	9.61	ne
Hexamethyldisilazane, 1,1,1,3,3,3- *	HMDS	999-97-3	$C_6H_{19}NSi_2$			0.2	+	0.2	+	~8.6	ne
Hexamethyldisiloxane	HMDSx	107-46-0	$C_6H_{18}OSi_2$	0.33	+	0.27	+	0.25	+	9.64	ne
Hexane, n-		110-54-3	C_6H_{14}	350	+	4.3	+	0.54	+	10.13	50
Hexanol, 1-	Hexyl alcohol	111-27-3	$C_6H_{14}O$	9	+	2.5	+	0.55	+	9.89	ne
Hexene, 1-		592-41-6	C_6H_{12}			0.8				9.44	30
HFE-7100 see Methyl nonafluorobutyl ether											
Histoclear (Histo-Clear)	Limonene/corn oil reagent		m.w. ~136	0.5	+	0.4	+	0.3	+		ne
Hydrazine *		302-01-2	H_4N_2	>8	+	2.6	+	2.1	+	8.1	0.01
Hydrazoic acid	Hydrogen azide		HN_3							10.7	
Hydrogen	Synthesis gas	1333-74-0	H_2	NR	+	NR	+	NR	+	15.43	ne
Hydrogen cyanide	Hydrocyanic acid	74-90-8	HCN	NR	+	NR	+	NR	+	13.6	C4.7
Hydrogen iodide *	Hydriodic acid	10034-85-2	HI			~0.6*				10.39	
Hydrogen peroxide		7722-84-1	H_2O_2	NR	+	NR	+	NR	+	10.54	1
Hydrogen sulfide		7783-06-4	H_2S	NR	+	3.3	+	1.5	+	10.45	10
Hydroxypropyl methacrylate		27813-02-1 923-26-2	$C_7H_{12}O_3$	9.9	+	2.3	+	1.1	+		ne
Iodine *		7553-56-2	I_2	0.1	+	0.1	+	0.1	+	9.40	C0.1

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Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Iodomethane	Methyl iodide	74-88-4	CH_3I	0.21	+	0.22	+	0.26	+	9.54	2
Isoamyl acetate	Isopentyl acetate	123-92-2	$C_7H_{14}O_2$	10.1		2.1		1.0		<10	100
Isobutane	2-Methylpropane	75-28-5	C_4H_{10}			100	+	1.2	+	10.57	ne
Isobutanol	2-Methyl-1-propanol	78-83-1	$C_4H_{10}O$	19	+	3.8	+	1.5		10.02	50
Isobutene	Isobutylene, Methyl butene	115-11-7	C_4H_8	1.00	+	1.00	+	1.00	+	9.24	Ne
Isobutyl acrylate	Isobutyl 2-propenoate	106-63-8	$C_7H_{12}O_2$			1.5	+	0.60	+		Ne
Isoflurane	1-Chloro-2,2,2-trifluoroethyl difluoromethyl ether, forane	26675-46-7	$C_3H_2ClF_5O$	NR	+	NR	+	48	+	~11.7	Ne
Isooctane	2,2,4-Trimethylpentane	540-84-1	C8H18			1.2				9.86	ne
Isopar E Solvent	Isoparaffinic hydrocarbons	64741-66-8	m.w. 121	1.7	+	0.8	+				Ne
Isopar G Solvent	Photocopier diluent	64742-48-9	m.w. 148			0.8	+				Ne
Isopar K Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 156	0.9	+	0.5	+	0.27	+		Ne
Isopar L Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 163	0.9	+	0.5	+	0.28	+		Ne
Isopar M Solvent	Isoparaffinic hydrocarbons	64742-47-8	m.w. 191			0.7	+	0.4	+		Ne
Isopentane	2-Methylbutane	78-78-4	C_5H_{12}			8.2					Ne
Isophorone		78-59-1	$C_9H_{14}O$					3		9.07	C5
Isoprene	2-Methyl-1,3-butadiene	78-79-5	C_5H_8	0.69	+	0.63	+	0.60	+	8.85	Ne
Isopropanol	Isopropyl alcohol, 2-propanol, IPA	67-63-0	C_3H_8O	500	+	6.0	+	2.7		10.12	200
Isopropyl acetate		108-21-4	$C_5H_{10}O_2$			2.6				9.99	100
Isopropyl ether	Diisopropyl ether	108-20-3	$C_6H_{14}O$			0.8				9.20	250
Jet fuel JP-4	Jet B, Turbo B, F-40 Wide cut type aviation fuel	8008-20-6 + 64741-42-0	m.w. 115			1.0	+	0.4	+		Ne
Jet fuel JP-5	Jet 5, F-44, Kerosene type aviation fuel	8008-20-6 + 64747-77-1	m.w. 167			0.6	+	0.5	+		29
Jet fuel JP-8	Jet A-1, F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 165			0.6	+	0.3	+		30
Jet fuel A-1 (JP-8)	F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 145			0.67					34
Jet Fuel TS	Thermally Stable Jet Fuel, Hydrotreated kerosene fuel	8008-20-6 + 64742-47-8	m.w. 165	0.9	+	0.6	+	0.3	+		30
Limonene, D-	(R)-(+)-Limonene	5989-27-5	$C_{10}H_{16}$			0.33	+			~8.2	Ne
Kerosene C10-C16 petro.distillate – see Jet Fuels		8008-20-6									
MDI – see 4,4'-Methylenebis(phenylisocyanate)											
Maleic anhydride	2,5-Furandione	108-31-6	$C_4H_2O_3$							~10.8	0.1
Mesitylene	1,3,5-Trimethylbenzene	108-67-8	C_9H_{12}	0.36	+	0.35	+	0.3	+	8.41	25
Methallyl chloride – see 3-Chloro-2-methylpropene											
Methane	Natural gas	74-82-8	CH_4	NR	+	NR	+	NR	+	12.61	Ne
Methanol	Methyl alcohol, carbinol	67-56-1	CH_4O	NR	+	NR	+	2.5	+	10.85	200
Methoxyethanol, 2-	Methyl cellosolve, Ethylene glycol monomethyl ether	109-86-4	$C_3H_8O_2$	4.8	+	2.4	+	1.4	+	10.1	5
Methoxyethoxyethanol, 2-	2-(2-Methoxyethoxy)ethanol Diethylene glycol monomethyl ether	111-77-3	$C_7H_{16}O$	2.3	+	1.2	+	0.9	+	<10	Ne
Methoxyethyl ether, 2-	bis(2-Methoxyethyl) ether, Diethylene glycol dimethyl ether, Diglyme	111-96-6	$C_6H_{14}O_3$	0.64	+	0.54	+	0.44	+	<9.8	Ne
Methyl acetate		79-20-9	$C_3H_6O_2$	NR	+	6.6	+	1.4	+	10.27	200
Methyl acrylate	Methyl 2-propenoate, Acrylic acid methyl ester	96-33-3	$C_4H_6O_2$			3.7	+	1.2	+	(9.9)	2
Methylamine	Aminomethane	74-89-5	CH_5N			1.2				8.97	5
Methyl amyl ketone	MAK, 2-Heptanone, Methyl pentyl ketone	110-43-0	$C_7H_{14}O$	0.9	+	0.85	+	0.5	+	9.30	50
Methyl bromide	Bromomethane	74-83-9	CH_3Br	110	+	1.7	+	1.3	+	10.54	1
Methyl t-butyl ether	MTBE, *tert*-Butyl methyl ether	1634-04-4	$C_5H_{12}O$			0.9	+			9.24	40
Methyl cellosolve	see 2-Methoxyethanol										
Methyl chloride	Chloromethane	74-87-3	CH_3Cl	NR	+	NR	+	0.74	+	11.22	50
Methylcyclohexane		107-87-2	C_7H_{14}	1.6	+	0.97	+	0.53	+	9.64	400
Methylene bis(phenyl-isocyanate), 4,4'- *	MDI, Mondur M		$C_{15}H_{10}N_2O_2$	Very slow ppb level response							0.005

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Methylene chloride	Dichloromethane	75-09-2	CH_2Cl_2	NR	+	NR	+	0.89	+	11.32	25
Methyl ether	Dimethyl ether	115-10-6	C_2H_6O	4.8	+	3.1	+	2.5	+	10.03	Ne
Methyl ethyl ketone	MEK, 2-Butanone	78-93-3	C_4H_8O	0.86	+	0.9	+	1.1	+	9.51	200
Methylhydrazine	Monomethylhydrazine, Hydrazomethane	60-34-4	$C_2H_6N_2$	1.4	+	1.2	+	1.3	+	7.7	0.01
Methyl isoamyl ketone	MIAK, 5-Methyl-2-hexanone	110-12-3	$C_7H_{14}O$	0.8	+	0.76	+	0.5	+	9.28	50
Methyl isobutyl ketone	MIBK, 4-Methyl-2-pentanone	108-10-1	$C_6H_{12}O$	0.9	+	0.8	+	0.6	+	9.30	50
Methyl isocyanate	CH3NCO	624-83-9	C_2H_3NO	NR	+	4.6	+	1.5		10.67	0.02
Methyl isothiocyanate	CH3NCS	551-61-6	C_2H_3NS	0.5	+	0.45	+	0.4	+	9.25	ne
Methyl mercaptan	Methanethiol	74-93-1	CH_4S	0.65		0.54		0.66		9.44	0.5
Methyl methacrylate		80-62-6	$C_5H_8O_2$	2.7	+	1.5	+	1.2	+	9.7	100
Methyl nonafluorobutyl ether	HFE-7100DL	163702-08-7, 163702-07-6	$C_5H_3F_9O$			NR	+	~35	+		ne
Methyl-1,5-pentanediamine, 2- (coats lamp) *	Dytek-A amine, 2-Methyl pentamethylenediamine	15520-10-2	C6H16N2			~0.6	+			<9.0	ne
Methyl propyl ketone	MPK, 2-Pentanone	107-87-9	$C_5H_{12}O$			0.93	+	0.79	+	9.38	200
Methyl-2-pyrrolidinone, N-	NMP, N-Methylpyrrolidone, 1-Methyl-2-pyrrolidinone, 1-Methyl-2-pyrrolidone	872-50-4	C_5H_9NO	1.0	+	0.8	+	0.9	+	*9.17*	ne
Methyl salicylate	Methyl 2-hydroxybenzoate	119-36-8	C_8H_8O3	1.3	+	0.9	+	0.9	+	~9	ne
Methylstyrene, α-	2-Propenylbenzene	98-83-9	C_9H_{10}			0.5				8.18	50
Methyl sulfide	DMS, Dimethyl sulfide	75-18-3	C_2H_6S	0.49	+	0.44	+	0.46	+	8.69	ne
Mineral spirits	Stoddard Solvent, Varsol 1, White Spirits	8020-83-5 8052-41-3 68551-17-7	m.w. 144	1.0		0.69	+	0.38	+		100
Mineral Spirits - Viscor 120B Calibration Fluid, b.p. 156-207°C		8052-41-3	m.w. 142	1.0	+	0.7	+	0.3	+		100
Monoethanolamine - see Ethanolamine											
Mustard *	HD, Bis(2-chloroethyl) sulfide	505-60-2 39472-40-7 68157-62-0	$C_4H_8Cl_2S$			0.6					0.0005
Naphtha - see VM & P Naptha											
Naphthalene	Mothballs	91-20-3	$C_{10}H_8$	0.45	+	0.42	+	0.40	+	8.13	10
Nickel carbonyl (in CO)	Nickel tetracarbonyl	13463-39-3	C_4NiO_4			0.18				<8.8	0.001
Nicotine		54-11-5	$C_{10}H_{14}N_2$			2.0				≤10.6	
Nitric oxide		10102-43-9	NO	~6		5.2	+	2.8	+	9.26	25
Nitrobenzene		98-95-3	$C_6H_5NO_2$	2.6	+	1.9	+	1.6	+	9.81	1
Nitroethane		79-24-3	$C_2H_5NO_2$					3		10.88	100
Nitrogen dioxide		10102-44-0	NO_2	23	+	16	+	6	+	9.75	3
Nitrogen trifluoride		7783-54-2	NF_3	NR		NR		NR		13.0	10
Nitromethane		75-52-5	CH_3NO_2					4		11.02	20
Nitropropane, 2-		79-46-9	$C_3H_7NO_2$					2.6		10.71	10
Nonane		111-84-2	C_9H_{20}			1.4				9.72	200
Norpar 12	n-Paraffins, mostly C_{10}-C_{13}	64771-72-8	m.w. 161	3.2	+	1.1	+	0.28	+		ne
Norpar 13	n-Paraffins, mostly C_{13}-C_{14}	64771-72-8	m.w. 189	2.7	+	1.0	+	0.3	+		ne
Octamethylcyclotetrasiloxane		556-67-2	$C_8H_{24}O_4Si_4$	0.21	+	0.17	+	0.14	+		ne
Octamethyltrisiloxane		107-51-7	$C_8H_{24}O_2Si_3$	0.23	+	0.18	+	0.17	+	<10.0	ne
Octane, n-		111-65-9	C_8H_{18}	13	+	1.8	+			9.82	300
Octene, 1-		111-66-0	C_8H_{16}	0.9	+	0.75	+	0.4	+	9.43	75
Pentane		109-66-0	C_5H_{12}	80	+	8.4	+	0.7	+	10.35	600
Peracetic acid *	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$	NR	+	NR	+	2.3	+		ne
Peracetic/Acetic acid mix *	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$			50	+	2.5	+		ne
Perchloroethene	PCE, Perchloroethylene, Tetrachloroethylene	127-18-4	C_2Cl_4	0.69	+	0.57	+	0.31	+	9.32	25
PGME	Propylene glycol methyl ether, 1-Methoxy-2-propanol	107-98-2	$C_6H_{12}O_3$	2.4	+	1.5	+	1.1	+		100

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PGMEA	Propylene glycol methyl ether acetate, 1-Methoxy-2-acetoxypropane, 1-Methoxy-2-propanol acetate	108-65-6	$C_6H_{12}O_3$	1.65	+	1.0	+	0.8	+		ne
Phenol	Hydroxybenzene	108-95-2	C_6H_6O	1.0	+	1.0	+	0.9	+	8.51	5
Phosgene	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	8.5	+	11.2	0.1
Phosgene in Nitrogen	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	6.8	+	11.2	0.1
Phosphine (coats lamp)		7803-51-2	PH_3	28		3.9	+	1.1	+	9.87	0.3
Photocopier Toner	Isoparaffin mix					0.5	+	0.3	+		ne
Picoline, 3-	3-Methylpyridine	108-99-6	C_6H_7N			0.9				9.04	ne
Pinene, α-		2437-95-8	$C_{10}H_{16}$			0.31	+	0.47		8.07	ne
Pinene, β-		18172-67-3	$C_{10}H_{16}$	0.38	+	0.37	+	0.37	+	~8	100
Piperylene, isomer mix	1,3-Pentadiene	504-60-9	C_5H_8	0.76	+	0.69	+	0.64	+	8.6	100
Propane		74-98-6	C_3H_8			NR	+	1.8	+	10.95	2500
Propanol, n-	Propyl alcohol	71-23-8	C_3H_8O			5		1.7		10.22	200
Propene	Propylene	115-07-1	C_3H_6	1.5	+	1.4	+	1.6	+	9.73	ne
Propionaldehyde	Propanal	123-38-6	C_3H_6O			1.9				9.95	ne
Propyl acetate, n-		109-60-4	$C_5H_{10}O_2$			3.5		2.3		10.04	200
Propylamine, n-	1-Propylamine, 1-Aminopropane	107-10-8	C_3H_9N	1.1	+	1.1	+	0.9	+	8.78	ne
Propylene carbonate *		108-32-7	$C_4H_6O_3$			62	+	1	+	10.5	ne
Propylene glycol	1,2-Propanediol	57-55-6	$C_3H_8O_2$	18		5.5	+	1.6	+	<10.2	ne
Propylene glycol propyl ether	1-Propoxy-2-propanol	1569-01-3	$C_6H_{14}O_2$	1.3	+	1.0	+	1.6	+		ne
Propylene oxide	Methyloxirane	75-56-9 16088-62-3 15448-47-2	C_3H_6O	~240		6.6	+	2.9	+	10.22	20
Propyleneimine	2-Methylaziridine	75-55-8	C_3H_7N	1.5	+	1.3	+	1.0	+	9.0	2
Propyl mercaptan, 2-	2-Propanethiol, Isopropyl mercaptan	75-33-2	C_3H_8S	0.64	+	0.66	+			9.15	ne
Pyridine		110-86-1	C_5H_5N	0.78	+	0.7	+	0.7	+	9.25	5
Pyrrolidine (coats lamp)	Azacyclohexane	123-75-1	C_4H_9N	2.1	+	1.3	+	1.6	+	~8.0	ne
RR7300 (PGME/PGMEA)	70:30 PGME:PGMEA (1-Methoxy-2-propanol:1-Methoxy-2-acetoxypropane)	107-98-2	$C_4H_{10}O_2$ / $C_6H_{12}O_3$			1.4	+	1.0	+		ne
Sarin	GB, Isopropyl methylphosphonofluoridate	107-44-8 50642-23-4	$C_4H_{10}FO_2P$			~3					
Stoddard Solvent - see Mineral Spirits		8020-83-5									
Styrene		100-42-5	C_8H_8	0.45	+	0.40	+	0.4	+	8.43	20
Sulfur dioxide		7446-09-5	SO_2	NR		NR	+	NR	+	12.32	2
Sulfur hexafluoride		2551-62-4	SF_6	NR		NR		NR		15.3	1000
Sulfuryl fluoride	Vikane	2699-79-8	SO_2F_2	NR		NR		NR		13.0	5
Tabun *	Ethyl N, N-dimethylphosphoramidocyanidate	77-81-6	$C_5H_{11}N_2O_2P$			0.8					15ppt
Tetrachloroethane, 1,1,1,2-		630-20-6	$C_2H_2Cl_4$					1.3		~11.1	ne
Tetrachloroethane, 1,1,2,2-		79-34-5	$C_2H_2Cl_4$	NR	+	NR	+	0.60	+	~11.1	1
Tetrachlorosilane		10023-04-7	$SiCl_4$	NR		NR		15	+	11.79	ne
Tetraethyl lead	TEL	78-00-2	$C_8H_{20}Pb$	0.4		0.3		0.2		~11.1	0.008
Tetraethyl orthosilicate	Ethyl silicate, TEOS	78-10-4	$C_8H_{20}O_4Si$			0.7	+	0.2	+	~9.8	10
Tetrafluoroethane, 1,1,1,2-	HFC-134A	811-97-2	$C_2H_2F_4$			NR		NR			ne
Tetrafluoroethene	TFE, Tetrafluoroethylene, Perfluoroethylene	116-14-3	C_2F_4			~15				10.12	ne
Tetrafluoromethane	CFC-14, Carbon tetrafluoride	75-73-0	CF_4			NR	+	NR	+	>15.3	ne
Tetrahydrofuran	THF	109-99-9	C_4H_8O	1.9	+	1.7	+	1.0	+	9.41	200
Tetramethyl orthosilicate	Methyl silicate, TMOS	681-84-5	$C_4H_{12}O_4Si$	10	+	1.9	+			~10	1
Therminol® D-12 *	Hydrotreated heavy naphtha	64742-48-9	m.w. 160	0.8	+	0.51	+	0.33	+		ne
Therminol® VP-1 *	Dowtherm A, 3:1 Diphenyl oxide: Biphenyl	101-84-8 92-52-4	$C_{12}H_{10}O$ $C_{12}H_{10}$			0.4	+				1
Toluene	Methylbenzene	108-88-3	C_7H_8	0.54	+	0.50	+	0.51	+	8.82	50

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Tolylene-2,4-diisocyanate	TDI, 4-Methyl-1,3-phenylene-2,4-diisocyanate	584-84-9	$C_9H_6N_2O_2$	1.4	+	1.4	+	2.0	+		0.002
Trichlorobenzene, 1,2,4-	1,2,4-TCB	120-82-1	$C_6H_3Cl_3$	0.7	+	0.46	+			9.04	C5
Trichloroethane, 1,1,1-	1,1,1-TCA, Methyl chloroform	71-55-6	$C_2H_3Cl_3$			NR	+	1	+	11	350
Trichloroethane, 1,1,2-	1,1,2-TCA	79-00-5	$C_2H_3Cl_3$	NR	+	NR	+	0.9	+	11.0	10
Trichloroethene	TCE, Trichoroethylene	79-01-6	C_2HCl_3	0.62	+	0.54	+	0.43	+	9.47	50
Trichloromethylsilane	Methyltrichlorosilane	75-79-6	CH_3Cl_3Si	NR		NR		1.8	+	11.36	ne
Trichlorotrifluoroethane, 1,1,2-	CFC-113	76-13-1	$C_2Cl_3F_3$			NR		NR		11.99	1000
Triethylamine	TEA	121-44-8	$C_6H_{15}N$	0.95	+	0.9	+	0.65	+	7.3	1
Triethyl borate	TEB; Boric acid triethyl ester	150-46-9	$C_6H_{15}O_3B$			2.2	+	1.1	+	~10	ne
Triethyl phosphate	Ethyl phosphate	78-40-0	$C_6H_{15}O_4P$	~50	+	3.1	+	0.60	+	9.79	ne
Trifluoroethane, 1,1,2-		430-66-0	$C_2H_3F_3$					34		*12.9*	ne
Trimethylamine		75-50-3	C_3H_9N			0.9				7.82	5
Trimethylbenzene, 1,3,5- - see Mesitylene		108-67-8									25
Trimethyl borate	TMB; Boric acid trimethyl ester, Boron methoxide	121-43-7	$C_3H_9O_3B$			5.1	+	1.2	+	10.1	ne
Trimethyl phosphate	Methyl phosphate	512-56-1	$C_3H_9O_4P$			8.0	+	1.3	+	9.99	ne
Trimethyl phosphite	Methyl phosphite	121-45-9	$C_3H_9O_3P$			1.1	+		+	*8.5*	2
Turpentine	Pinenes (85%) + other diisoprenes	8006-64-2	$C_{10}H_{16}$	0.37	+	0.30	+	0.29	+	~8	20
Undecane		1120-21-4	$C_{11}H_{24}$			2				9.56	ne
Varsol – see Mineral Spirits											
Vinyl actetate		108-05-4	$C_4H_6O_2$	1.5	+	1.2	+	1.0	+	9.19	10
Vinyl bromide	Bromoethylene	593-60-2	C_2H_3Br			0.4				9.80	5
Vinyl chloride	Chloroethylene, VCM	75-01-4	C_2H_3Cl			2.0	+	0.6	+	9.99	5
Vinyl-1-cyclohexene, 4-	Butadiene dimer, 4-Ethenylcyclohexene	100-40-3	C_8H_{12}	0.6	+	0.56	+			9.83	0.1
Vinylidene chloride - see 1,1-Dichloroethene											
Vinyl-2-pyrrolidinone, 1-	NVP, N-vinylpyrrolidone, 1-ethenyl-2-pyrrolidinone	88-12-0	C_6H_9NO	1.0	+	0.8	+	0.9	+		ne
Viscor 120B - see Mineral Spirits - Viscor 120B Calibration Fluid											
V. M. & P. Naphtha	Ligroin; Solvent naphtha; Varnish maker's & painter's naptha	64742-89-8	m.w. 111 (C_8-C_9)	1.7	+	0.97	+				300
Xylene, m-	1,3-Dimethylbenzene	108-38-3	C_8H_{10}	0.50	+	0.44	+	0.40	+	8.56	100
Xylene, o-	1,2-Dimethylbenzene	95-47-6	C_8H_{10}	0.56	+	0.46	+	0.43		8.56	100
Xylene, p-	1,4-Dimethylbenzene	106-42-3	C_8H_{10}	0.48	+	0.39	+	0.38	+	8.44	100
None				1		1		1			
Undetectable				1E+6		1E+6		1E+6			

* Compounds indicated in green can be detected using a MiniRAE 2000 or ppbRAE/+ with slow response, but may be lost by adsorption on a MultiRAE or EntryRAE. Response on multi-gas meters can give an indication of relative concentrations, but may not be quantitative and for some chemicals no response is observed.

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Appendix I:
Example of Automatic Calculation of Correction Factors, TLVs and Alarm Limits for Mixtures
(Calculations performed using Excel version of this database, available on request)

Compound	CF 9.8 eV	CF 10.6 eV	CF 11.7eV	Mol. Frac	Conc ppm	TLV ppm	STEL Ppm
Benzene	0.55	0.53	0.6	0.01	1	0.5	2.5
Toluene	0.54	0.5	0.51	0.06	10	50	150
Hexane, n-	300	4.3	0.54	0.06	10	50	150
Heptane, n-	45	2.8	0.6	0.28	50	400	500
Styrene	0.45	0.4	0.42	0.06	10	20	40
Acetone	1.2	1.1	1.4	0.28	50	750	1000
Isopropanol	500	6	2.7	0.28	50	400	500
None	1	1	1	0.00	0	1	
Mixture Value:	2.1	1.5	0.89	1.00	181	56	172
TLV Alarm Setpoint when Calibrated to Isobutylene:	26 ppm	37 ppm	62 ppm		ppm	ppm	ppm
STEL Alarm Setpoint, same Calibration	86 ppm	115 ppm	193 ppm				

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ToxiRAE Pro PID

Personal Wireless Monitor for Volatile Organic Compounds

The ToxiRAE Pro PID is the world's smallest wireless volatile organic compounds (VOC) monitor[1,2]. The ToxiRAE Pro PID takes worker protection to the next level by providing safety professionals wireless access to real-time instrument readings and alarm status from any location for better visibility and faster response. Featuring RAE Systems' next-generation PID sensor, the ToxiRAE Pro PID can promptly detect and accurately monitor over 300 VOCs. With an onboard library of 190 correction factors, the ToxiRAE Pro PID can be programmed to automatically read in concentrations of the specified compound.

- **World's smallest photoionization detector**
- **Wireless elevates worker protection to the next level**
- **Cutting-edge PID with 0.1 to 2,000 ppm range, 0.1 ppm resolution[3] and 190 built-in correction factors**
- **Available in Industrial Hygiene (advanced) or Safety (basic)[2] configurations**

KEY FEATURES

Wireless. Personal. Proven.

- Wireless access to real-time instrument readings and alarm status from any location
- Unmistakable five-way local and remote wireless notification of alarm conditions
- Reliable, rugged, and intrinsically safe
- Largest display in its class
- Continuous datalogging[3]
- Fully automated bump testing and calibration with AutoRAE 2[2]
- User-replaceable sensor, filter, fan, and Lithium-ion battery

APPLICATIONS

- Industrial hygiene and safety
  - Oil and gas
  - Chemical plants
  - Pharmaceutical plants
  - Government health, safety, security, and environmental agencies
  - Hazardous materials teams, first responders
- Environmental applications
  - Environmental consulting
  - Soil remediation

Worker exposure monitoring with ToxiRAE Pro PID

Wireless AutoRAE 2 Compatible ISO 9001 CERTIFIED ATEX IECEx FCC

ToxiRAE Pro PID

Personal Wireless Monitor for Volatile Organic Compounds

SPECIFICATIONS[4]

Size	4.6" H x 2.4" W x 1.2" D (118 x 60 x 30 mm)
Weight	8.29 oz. (235 g.)
Sensor	Photoionization sensor with 10.6 eV (standard) or 9.8 eV[2,3] (optional) lamp. Response time (T_{90}) < 15 sec. (Isobutene). Field-replaceable sensor. Easy access to lamp for cleaning
Detectable Gases	A wide variety of ionizable chemicals using 190 built-in and over 300 published correction factors
Battery	Rechargeable Lithium-ion battery - Operating time: > 12 hours (normal operation) - Recharge time: < 4 hours through charging cradle
Display	Graphical LCD display with white LED backlighting (activated when monitor is in alarm or with a button press)
Display Readout	- Real-time reading of VOC concentrations in parts per million or mg/m^3; battery status; data logging on/off; wireless on/off and reception quality - STEL, TWA, and peak values - Calibration and measurement gases; correction factors
Keypad	2 buttons for operation and programming
Sampling	Internal fan
Calibration	Automatic with AutoRAE 2 Test and Calibration Station[2] or manual
Alarm Modes	Wireless remote alarm notification[1,2]; audible (95 dB @ 30 cm), vibration, visible alarm (flashing bright red LEDs), and on-screen indication of alarm conditions - High alarm: 3 beeps and flashes per second - Low alarm: 2 beeps and flashes per second - STEL and TWA: 1 beep and flash per second - Additional diagnostic alarm and display message for low battery and fan stall
Datalogging	- Continuous datalogging[3] with a three-month capacity (at one-minute intervals) - User-configurable datalogging interval (from 1 to 3,600 seconds)
Communication and Data Download	- Data download and instrument set-up on PC via charging and PC comm. cradle - Data download via AutoRAE 2 Automated Test and Calibration Station[2] - Wireless data and status transmission[1,2] via built-in RF modem (optional)
Wireless Network	RAE Systems Dedicated Wireless Network
Wireless Frequency[1,2]	ISM license-free bands
Wireless Range[1,2] (Typical)	300 feet (100 meters)
Operating Temperature	-4° to 131°F (-20° to 55°C)
Humidity	0% to 95% relative humidity (non-condensing)
Dust and Water Resistance	IP-54 rating for dust and water ingress protection (validated by an independent test laboratory)
Hazardous Location Approvals	US and Canada: c(SP)us Class I, Division 1, Groups A, B, C and D. T-code T4 Class I, Zone 0 A/Exia IIC T4 Europe: ATEX: CE, Ex II 1G, Ex ia IIC Ga T4 IECEx: Ex ia IIC Ga T4 China: Ex ia IIC T4
CE Compliance (European Conformity)	EMC directive: 2004/108/EC. R&TTE directive: 1999/5/EC. ATEX directive: 94/9/EC
Warranty	- Two years on non-consumable components - One year on sensor, fan, battery, and other consumable parts

[1] Wireless functionality is scheduled for availability in 2011 in North America and Europe. Contact RAE Systems for availability in other regions.
[2] Contact RAE Systems for availability.
[3] Available with Industrial Hygiene configurations only.
[4] Specifications are subject to change.
[5] Wireless units have a functioning RF modem and are ready for wireless deployments; Wireless-capable units can be upgraded to wireless in the field for a fee; Non-wireless units cannot be upgraded to wireless. Additional equipment and/or software licenses may be required to enable remote wireless monitoring and alarm transmission.

TOXIRAE PRO PID COMES WITH:

- ToxiRAE Pro PID monitor with sensor as specified, alligator clip, protective rubber boot, and rechargeable battery installed
- Charging and PC communication cradle
- PC communication cable
- AC adapter (100 to 240 V, 50/60 Hz AC to 12 V DC)
- Calibration adapter
- Combined instrument/sensor cap removal tool
- Quick Start Guide
- CD with documentation
- ProRAE Studio II software for PC-based instrument configuration and data management
- Technical Note TN-106 with ionization energies and correction factors for 300+ VOCs (Industrial Hygiene versions only)
- Calibration card; quality certificate; packing list; and warranty/registration card

OPTIONAL ACCESSORIES

- AutoRAE 2 Automated Test and Calibration Station[2]
- Multi-unit charging station[2] for up to five monitors
- Refer to the Portables Pricing Guide for other accessories, maintenance kits, gas, sensors, and replacement parts

ORDERING INFORMATION (MODEL: PGM-1800)

- Industrial Hygiene (advanced) and Safety (basic)[2] configurations are available

  Industrial Hygiene configurations:
  - Advanced PID sensor (10.6 eV; 0.1 to 2,000 ppm; 0.1 ppm resolution)
  - Datalogging
  - 9.8 eV[2,3] or 10.6 eV lamp options

  Safety configurations[2]:
  - 10.6 eV; 1 to 1,000 ppm; 1 ppm resolution PID
  - No datalogging
  - 10.6 eV lamp option only
- Wireless, wireless-capable, or non-wireless versions are available[1,2,5]
- Refer to the Portables Pricing Guide for part numbers

Toll-Free: 877-723-2878

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DS-1063-01

DOMINUS®

APPLICATION LOG

Please visit isagro-usa.com for an electronic version for completion and submission.

Direct link is *http://www.isagro-usa.com/downloads/Isagro_Dominus_TrialLog_r8_fillable.pdf*

APPLICATION LOG

1. Date of Application:
2. Farm/Grower/Location:
3. Distributor: ◯ TriEst ◯ CPS ◯ Howard Fertilizer
4. Applicator Name:
5. Applicator Phone:
5. Application Method: ◯ Raised Bed Shank ◯ Raised Bed Drip ◯ Flat Fume
6. Crop:
7. Rate: gpa or lbs/A (broadcast acre)
8. Tarp Type: ◯ LDPE ◯ HDPE ◯ VIF ◯ TIF
9. Planting Date / / 20
10. Target Soil Pests: ☐ Weeds ☐ Fungi ☐ Nematodes
11. DOMINUS Acres Treated:
12. Field Size (acres):

Prior to application, you must submit form to Isagro USA. Chris Leon, cleon@isagro-usa.com; Daren Sapp, dsapp@isagro-usa.com; and Taylor Ivy, tivy@isagro-usa.com

SUBMIT CLEAR

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